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PROGRAMMATIC ASSESSMENT OF RADIOACTIVE WASTE MANAGEMENT

Prepared for

Oak Ridge National Laboratory
Union Carbide Corporation
Nuclear Division

Gilbert/Commonwealth
ENGINEERS/CONSULTANTS Reading,PA/Jackson,MI

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PROGRAMMATIC ASSESSMENT OF RADIOACTIVE WASTE MANAGEMENT

NUCLEAR FUEL AND WASTE PROGRAMS

Operational Planning and Development
(Activity No. AR 05 10 05 K; ONL-WN06)

PREPARED FOR

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
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READING, PENNSYLVANIA
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SECTION 1.0
INTRODUCTION

Gilbert/Commonwealth (G/C) has performed an assessment of the waste management operations at Oak Ridge National Laboratory (ORNL). The objective of this study was to review radioactive waste management as practiced at ORNL and to recommend improvements or alternatives for further study.

The study involved: 1) an on-site survey of ORNL radioactive waste management operations; 2) a review of radioactive waste source data, records, and regulatory requirements; 3) an assessment of existing and planned treatment, storage, and control facilities; and 4) identification of alternatives for improving waste management operations. Information for this study was obtained from both personal interviews and written reports.

Section 2.0 summarizes the G/C suggestions for improving ORNL waste management operations. Regulatory requirements governing ORNL waste management operations are discussed in Section 3.0. Descriptions and discussions of the radioactive liquid, solid, and gaseous waste systems are presented in Sections 4.0, 5.0,and 6.0, respectively. The waste operations control complex is discussed in Section 7.0.

SECTION 2.0
PROGRAMATIC ASSESSMENT

A major conclusion from this assessment is that the ORNL waste management operations have maintained radioactive releases to the environment well below regulatory requirements and have been successful, in recent years, in consistently reducing emissions. This has been accomplished primarily by upgrading equipment and procedures. However, this upgrading must be an on-going activity because of 1) the changing nature of ORNL activities, 2) an increase in radioactive burden on-site, 3) the age of existing facilities and equipment, and 4) changes to regulatory requirements. As a result of reviewing ORNL operations, specific suggestions are offered for resolving isolated problems. However, these suggestions should be considered in the context of a comprehensive plan for the management of radioactive wastes at ORNL. Three areas were determined to warrant more detailed, consolidated studies: 1) waste management program planning, 2) development of a centralized computer based data acquisition system, and 3) a review for maintaining exposures to on-site personnel "as low as reasonable achievable" (ALARA).

2.1 WASTE MANAGEMENT PROGRAM PLANNING

The major problem to be resolved by ORNL waste management operations is one of overall management policies and direction. The existing radioactive waste systems and equipment reflect the evolution and growth of ORNL and changes in regulatory requirements. However, systems and equipment were designed, installed, modified, and eliminated without an overall plan. Accordingly, the development of a waste management program plan is considered to be of primary importance. This plan should be developed in greater detail than would be required to satisfy the requirements of the DOE Manual Chapter 0511-038C Part II(1). A recommended outline for a radioactive waste management plan to satisfy regulatory requirements is presented in Appendix A.

2.2 CENTRALIZED COMPUTER BASED DATA ACQUISITION SYSTEM

Renovations are currently being considered for the existing instrumentation systems for monitoring and controlling waste. However, future uses and desired flexibility should also be considered in terms of overall cost and benefits.

The current instrumentation system design consists of two distinct parts, the remote sensing equipment (level, sampling, detectors, and count-rate meter instrumentation), and the Control Complex Building 3105 monitoring, alarm, and recording instrumentation. All equipment is operational and serves its intended purpose. The system, however, has been in operation for many years, and renovation appears to be necessary.

The Rust Engineering Company Conceptual Design Report for the Waste Operations Control Center Renovation (Project No. 80-ORNL-16, Contract No. EY-77-C-05-5371) presents a data acquisition system design(2). However, design benefits and alternatives are not presented in sufficient detail to show that the upgrade would provide the most benefit to ORNL for its cost.

A comprehensive study of the design would result in specific subsystem recommendations and renovations. A brief outline of a type of design which would provide more flexibility for the ORNL Waste Operations Control Center is presented in Appendix B.

2.3 ALARA REVIEW

Another conclusion of this study is that an ALARA program may be beneficial at ORNL because of the following: 1) future planned decontamination and decommissioning operations will increase volume and activity levels of waste to be processed, thereby resulting in increased man-rem exposures; 2) in many cases, high maintenance items (valves, lubrication fittings, etc.) are located in proximity to process equipment and do not reflect current ALARA philosophies; and 3) evaluations are underway to study reduced radiation exposure limits below the current 5 rem/yr limit(3). An ALARA program would identify potential problem areas and suggest cost-effective procedural and/or equipment solutions. The recommendations for this program are described in Appendix C.

2.4 SUMMARY TABLE

Table 2.4-1 is a summary of the recommendations/conclusions that warrant further investigation. Most of these would be addressed in the major programs recommended above and are discussed in Appendices A, B, and C.

2.5 REFERENCES

1. DOE Manual, Chapter 0511.

2. Rust Engineering Co., "Conceptual Design Report for the ORNL Waste Operations Control Center (80-ORNL-16)," July 28, 1978.

3. Federal Register, Vol. 44, No. 35, p. 10388, February 20, 1979.

4. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Regulation of Federal Radioactive Waste Activities, NUREG-0527, September 1979.

5. ANSI N13.1(1969), Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.

TABLE 2.4-1

WASTE MANAGEMENT
OPERATIONS ASSESSMENT

Recommendations/Conclusions	Major Program Reference Appendix	Comments
Regulations		
Prepare annually updated Waste Management Plan	A	DOE Manual 0511-038C requires that this plan be prepared. See Section 3.0.
Perform a review of ORNL procedures to determine the degree of compliance with NRC licensing requirements	-	IRG recommendations and NUREG 0527(4) indicate that NRC regulatory authority could be extended to new DOE facilities for disposal of TRU and nondefense low level wastes. See Section 3.1.
Liquids		
Low Level Waste		Reference Section 4.1.6
Review activity release from burial site run-off	A	Cost/benefit of alternatives should be reviewed to mitigate activity releases
Review tank farm leaks and potential leak sources to LLW system	A	Could reduce activity burden to LLW treatment system
Review diversion of LLW sources prior to treatment	A	Reduce waste volume processed in LLW treatment system
Review sludge collection, treatment, and disposal	A	DOE Manual 0511 requires sludge treatment, solidification, and proper burial
Analyze cost/benefit of monitoring/sampling equipment changeout	-	
Intermediate Level Waste		Reference Section 4.2.6
Review data reporting of Curie content and inventory in waste source collection and storage tanks	B	Provides accountability and ORNL waste management controls for processing
Review waste source and volume data	B	Waste management group would be better able to exercise control over the wastes they receive
Review effects of facility decon solutions on evaporator process capabilities	A	Assure compatibility between solvents and waste evaporator

TABLE 2.4-1 (Cont'd)

WASTE MANAGEMENT OPERATIONS ASSESSMENT

Recommendations/Conclusions	Major Program Reference Appendix	Comments
High Level and Transuranium Waste		Reference Sections 4.3.6 and 4.4.6
Review HLW system in detail	A	
Assess mixing of OR-ILW and HLW and alternative methods of solidification	A	
Establish administrative procedures for collection and processing of transuranium waste	A	
Review alternate disposal techniques if transuranium waste exceeds administrative levels	A	Retrievability is required if TRU concentration exceeds 10 nCi/gm(1)
Solids		Reference Section 5.6
Review potential for volume reduction techniques such as slagging pyrolysis	A	
Review decontamination of equipment to avoid burial	A	
Review cost/benefit of compaction for TRU waste	A	
Assess waste container geometry	-	Square containers are less costly than currently used 55 gal drums
Assess desirability of providing interim retrievable storage for solid waste while alternate disposal methods are being evaluated; review unpackaged burial of radioactive waste; review burial ground runoff data	A	
Gases		Reference Section 6.5
Review waste sources	B	Provide documentation for waste sources
Analyze cost/benefit for holdup capability for iodine/noble gases	A	Provide added holdup flexibility
Review gas treatment practices in areas which contain significant quantities of radioactive gas	A	

TABLE 2.4-1 (Cont'd)

WASTE MANAGEMENT
OPERATIONS ASSESSMENT

Recommendations/Conclusions	Major Program Reference Appendix	Comments
Gases (Cont'd)		
Assess feasibility and specify design of an auto-isokinetic sample withdrawal system for 3039 stack	-	Sample withdrawal method is only marginally acceptable(5)
Review using pitot tube assembly for flow measurement	-	Stack flow rate instrumentation is inadequate
Review locating hardware inside housing at the base of the stack	-	Maintenance activities at the 3039 stack 50 ft elevation are hazardous
Analyze cost/benefit of monitoring/sampling equipment changeout	-	Equipment in the gaseous waste system is old and requires high maintenance
Monitor/Control		Reference Section 7.2
Determine need for a computerized data acquisition system	B	Control complex equipment is old and consists of high maintenance equipment at or near the end of its useful life

SECTION 3.0

FEDERAL REGULATIONS GOVERNING ORNL PRACTICES

Waste products generated at ORNL may be divided into three general categories: effluents, stored wastes, and disposed wastes. Effluents are routinely discharged to the biosphere, stored wastes are retrievable, and disposed wastes are isolated from the biosphere. These wastes can be in liquid, gas, and solid forms and be either radioactive or nonradioactive. This discussion will be limited to regulations concerning radioactive wastes.

With few exceptions, all radioactive waste materials should be either reduced to an innocuous form prior to discharge to the biosphere, recycled for reuse in process systems, or disposed of in an environmentally acceptable manner. If this goal is not immediately achievable, the waste materials must be controlled to minimize radiation exposures and potential risks to man and the biosphere over the lifetime of the radionuclides.

Conformance with Federal policy at ORNL is determined from DOE (AEC) Administration Manual chapters. Table 3.0-1 lists the manual chapters concerning radiation protection and waste management(1). The five chapters with the major influence on ORNL waste management operations (0510, 0511, 0513, 0524, and 0531) are discussed below.

Chapter 0510 specifies the requirements for air and water pollution control. Radioactive airborne and liquid effluents are specified in this chapter to be controlled in accordance with Chapter 0524. However, under Chapter 0510, the operation of the new hydrofracture facility at ORNL would have to comply with the Hazardous Waste Management Facility program of the Resource Conservation and Recovery Act(2), the Underground Injection Control program of the Safe Drinking Water Act(3), and the National Pollutant Discharge Elimination System of the Clean Water Act(4).

The EPA has proposed consolidated permit requirements for these programs to assure that permit decisions are consistent and that issuance procedures are efficient(5). This consolidation may assist ORNL in complying with these regulations for the new hydrofracture facility.

TABLE 3.0-1

DOE (AEC) ADMINISTRATION MANUAL CHAPTER OF PRIMARY IMPORTANCE TO RADIATION PROTECTION AND WASTE MANAGEMENT

Chapter	Title
0502	Modification, Investigation, and Reporting Of Occurrences
0510	Prevention, Control, and Abatement of Air and Water Pollution
0511	Radioactive Waste Management
0513	Effluent and Environmental Monitoring and Reporting
0524	Standards for Radiation Protection
0525	Occupational Radiation Exposure Information
0529	Safety Standards for Packaging of Fissile and Other Radioactive Materials
0531	Safety of Nonreactor Nuclear Facilities
0550	Operational Safety Standards

Operating criteria from Chapter 0511 requires that field offices and their contractors:

- "Conduct their operations to assure that radiation exposures to individuals and population groups will be at the lowest levels technically and economically practical not exceeding limits established in Chapter 0524 Appendix Parts I and II."

- "Continue efforts to develop and use improved technology for reducing the radioactivity releases to the lowest technically and economically practical level."

- Prohibit offsite transportation of high level liquid radioactive waste."

- "Minimize the extent and degree of radioactive contamination of land by DOE waste management activities."

Chapter 0511 also requires that all contractors prepare annually updated waste management plans for each site and maintain updated records of radioactive waste stored or buried at their sites.

Compliance with the reporting requirements of Chapter 0511 is fulfilled by reports prepared by several ORNL divisions, but preparation of the specified waste management plans have been discontinued by ORNL since 1976 by agreement with DOE Headquarters. An updated plan is being prepared in response to a new request dated November 30, 1979, from DOE.

Chapter 0513 requires evaluation of on-site discharges, liquid and gaseous effluents, and the immediate environment to assess the radioactive and nonradioactive pollutant levels for:

- Compliance with applicable Federal policies, standards, and requirements.

- Determining the adequacy of effluent control, environmental protection, and efforts to achieve levels of radioactivity which are as low as practical (ALAP).

Compliance with the reporting requirements of Chapter 0513 is fulfilled by reports prepared by several ORNL divisions.

Chapter 0524 requires that radiation exposure to individuals and population groups be limited to the lowest levels technically and economically practicable.

Compliance with the requirements of Chapter 0524 is accomplished by proper effluent control. Compliance is demonstrated by environmental, food chain, and personnel monitoring.

Chapter 0531 requires that environmental protection and health and safety matters be comprehensively addressed and reviewed to assure that all identifiable risks are reduced to ALAP. Another requirement is the implementation of an environmental, safety, and health (ES&H) program where potential significant safety hazards (assuming a release of a reasonable fraction of the nuclear material present) could result in:

- Radiation exposure in excess of established standards for off-site locations.
- A significant hazard onsite due to exposures to radiation.
- Significant property damage or loss onsite and/or offsite.

ORNL compliance with the requirements of Chapter 0531 has not been assessed in detail as part of this review.

3.1 FUTURE REGULATION

The Interagency Review Group (IRG) on Nuclear Waste Management has recommended that Nuclear Regulatory Commission (NRC) licensing authority should be extended, via new legislation, over all new DOE facilities for disposal of TRU waste and nondefense, low level wastes(6).

NUREG-0527 (7) was prepared in response to a directive in the NRC Authorization Bill for Fiscal 1979 which required NRC to conduct a study of extending the Commission's licensing or regulatory authority to include categories of existing and future Federal radioactive waste storage and disposal activities not presently subject to such authority.

The effect of this proposed legislation on ORNL operation cannot be predicted at this time. However, the potential costs of remedial actions or design changes could be substantial. Therefore, it is recommended that a review of ORNL procedures be conducted to determine the degree of compliance with NRC licensing requirements and to develop an estimate of the cost that could be incurred by this action.

3.2 REFERENCES

1. DOE Manual, Chapters

2. Environmental Protection Agency, Hazardous Waste Management Program, Resource Conservation and Recovery Act, October 21, 1976.

3. Environmental Protection Agency, Underground Injection Control Program, Safe Drinking Water Act, December 16, 1974 as amended November 16, 1977.

4. Environmental Protection Agency, National Pollutant Discharge Elimination System, Clean Water Act, December 27, 1977.

5. Federal Register, Vol. 44, No. 116, p. 34244, June 14, 1979.

6. Report to the President by the Interagency Review Group on Nuclear Waste Management, March 1979, TID-29442.

7. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Regulation of Federal Radioactive Waste Activities, NUREG-0527, September 1979.

SECTION 4.0

LIQUID WASTE

Liquid waste types are classified as low level waste (LLW) (controlled and uncontrolled), Oak Ridge intermediate level waste (OR-ILW), high level waste (HLW), and transuranic waste (TRU).

The only two streams treated directly are the controlled LLW and OR-ILW. Currently no HLW is produced. TRU-contaminated waste is diluted with and processed as OR-ILW.

4.1 LOW LEVEL WASTE

4.1.1 Sources/Releases

Several sources of liquid effluents contribute to the total annual low level waste releases to the biosphere from ORNL. These include both controlled and uncontrolled discharges. Controlled discharges include effluents from the LLW, sewage treatment plants, and waste ponds, while uncontrolled discharges include runoff and seepage from burial grounds and pits. Table 4.1-1 summarizes the sources of known discharges and values for the Sr-90 releases for the first six months of 1979(1). Approximately 95 percent of the activity released was from uncontrolled sources. Sampling stations and release sources are shown on Figure 4.1-1(1).

- Uncontrolled Releases

  Of the total Sr-90 released, 86.5 percent is due to seepage and/or runoff from Burial Grounds 3, 4 and 5. Also activity is suspected to enter the White Oak Dam from Burial Ground 6 and/or adjacent abandoned OR-ILW pits and trenches. Activity measured at the White Oak Dam Exit (Station 5) is generally lower than the total of that entering from the Melton Branch and White Oak Creek (Station 3 plus Station 4). This is probably due to a decanting action behind the dam.

TABLE 4.1-1

SOURCES OF LLW RELEASES TO BIOSPHERE(1)

Source	6 Month Activity (1979) Sr-90 mCi	% Total
Controlled:		
LLW Treatment Plant	7.4	0.4
Sewage Treatment Plant	75.3	4.5
Subtotal Controlled Sources	82.7	4.9
Uncontrolled:		
Burial Ground 3	206.5	12.4
Burial Ground 4	845.3	50.8
Burial Ground 5	386.3	23.3
7500 Area	4.3	2.6
7900 Area	1.7	0.1
190 Ponds	4.3	0.3
Flume (4500 Area)	93	5.6
Subtotal Uncontrolled Sources	1580.1	95.1
Total	1662.8	100

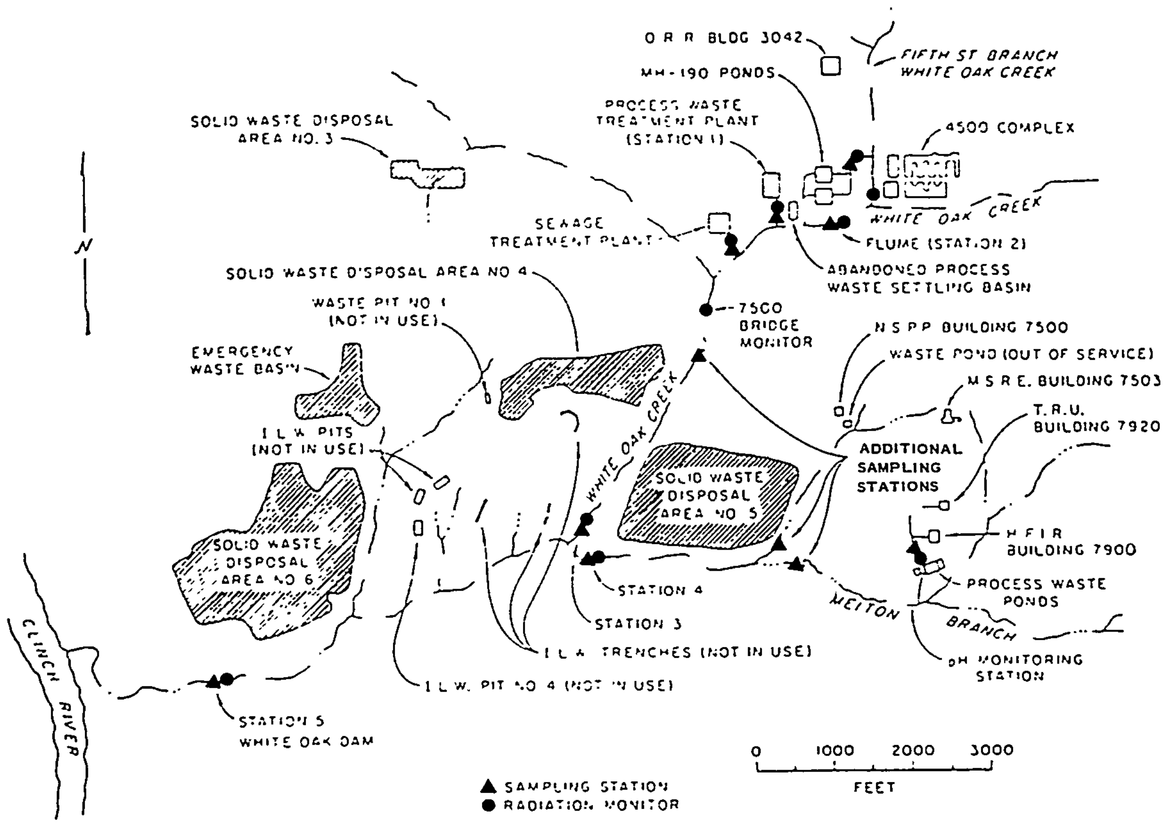

FIGURE 4.1-1
LOCATION OF SAMPLING STATIONS AND RELEASE SOURCES

Other uncontrolled releases are from the Flume (4500 area) and the 7500 area. These appear to be from rainwater runoff or seepage into various streams leading to White Oak Dam. These sources contribute approximately 8.6 percent of the total Sr-90 released; the flume (Station 2) is the largest of these other sources, accounting for 5.6 percent of the total activity released.

o Controlled Releases

The controlled releases originate at the sewage treatment plant and the LLW treatment plant. A review of the sewage treatment plant is not in the scope of this study, but the Sr-90 released from there during the first half of 1979 is significant enough to warrant attention. This contamination enters the sanitary system through old sections of clay pipe that have developed leaks which collect groundwater from contaminated areas. One important source of such contamination was eliminated in 1979.

LLW streams are normally not radioactive but could become contaminated because of equipment failure or human error. These process wastes include steam condensate from heating coils in vessels containing radioactive solutions, vessel cooling water, collected rainwater runoff from potentially contaminated areas, condensate from the intermediate level waste (OR-ILW) evaporator, some building sink and floor drains, etc. The normal sources of radioactivity in the LLW system are evaporator distillate and runoff from contaminated areas, such as the OR-ILW waste storage tank farm. The main contributors to this system are listed on Table 4.1-2.

The average monthly volumes and activities of the various LLW sources are summarized in Table 4.1-3 for the calendar years 1970 through the first half of 1979. Data were compiled from monthly reports on radioactive liquid waste disposal operations(1). Monthly volumes and activities are tabulated in Appendix D. A flow diagram showing the various sources is depicted in Figure 4.1-2.

The waste composition varies depending on ORNL activities, but a typical representative analysis is given in Table 4.1-4(2). The principal radioactive contaminants are Cs-137 and Sr-90.

TABLE 4.1-2

MAIN CONTRIBUTORS TO PROCESS WASTE TREATMENT PLANT

	Area	Monitoring Station Man-Hole Number	Avg Volume Millions Gal/Mo
o	Radioisotopes Processing Area	234	.13
o	Reactor Operations	112	.69
o	Ground Water In-Leakage (Building 3047)	114 minus 112	.68
o	High-Radiation-Level Chemical Engineering Laboratory (3503)	229	.74
o	Chemical Technology Alpha Laboratory (3508)		
o	Physical Examination - Hot cells (3025E)	149	.38
o	Solid State Division Laboratories (3025M)		
o	Radioisotope Development Laboratory B (3026C)		
o	Dismantling and Examination Hot Cells (3026D)		
o	Radiochemical Processing Pilot Plant (3019A)	25	.28
o	High Level Radiation Analytical Laboratory A (3019B)		
o	Radioactive Waste Evaporator (2531)	243	.33
o	High-Radiation-Level Examination Laboratory (3525)	235	.33
o	High-Radiation-Level Analytical Laboratory (2026)	240	.09
o	Tank Farm Drainage	-	1.45
	Total		5.10

NOTE:

Volumes based on the first 6 months of CY 1979(1).

TABLE 4.1-3

SUMMARY OF LOW LEVEL WASTE CONTRIBUTOR'S MONTHLY AVERAGE ACTIVITIES(1)
(MILLICURIES)

	1970 Gross-Beta	1971 Gross-Beta 8 Mon. Avg.	1971 Sr-90 10 Mon. Avg.	1972 Sr-90	1973 Gross-Beta 11 Mon. Avg.	1974 Gross-Beta	1975 Gross-Beta	1976 Gross-Beta	1977 Gross-Beta	1978 Gross-Beta 5 Mon Avg	1978 Sr-90 7 Mon Avg	1979 Sr-90 6 Mon Avg
Area (MH234)	305.0	277.5	105.0	47.5	55.5	40.0	90.0	61.4	27.7	21.0	24.0	12.3
Area (MH114-MH112)	-	-	357.5	334.2	255.5	225.0	215.8	358.8	315.5	305.2	158.3	313.2
MH112	570.8	936.3	306.0	10.0	16.4	44.2	23.2	8.1	5.3	7.6	1.3	3.2
Bldg. 3503 - 3508	35.5	45.0	21.0	43.3	133.6	67.5	6.6	2.1	4.4	1.8	1.4	1.0
Bldg. 3025 - 3026	16.4	11.3	9.1	10.0	14.5	10.0	9.3	3.1	7.9	2.2	2.6	1.0
Bldg. 3019	10.8	11.3	10.5	10.0	10.0	10.8	11.25	11.8	9.7	3.4	3.3	2.7
Bldg. 2531	24.2	87.5	405.0	214.2	306.7	35.0	81.4	78.0	26.3	17.8	28.1	17.0
Bldg. 3525	10.8	10.0	10.0	10.0	10.0	10.0	8.1	.3	1.8	.6	1.0	1.3
Bldg. 2026	10.0	10.5	10.0	10.8	10.0	10.0	6.2	.6	2.1	.8	1.3	1.0
Tank Farm Drainage	-	-	-	134.0	276.4	227.5	350.5	545.9	601.3	1080.6	444.3	751.7
Bldg. 3505, 3517	45.0	27.5	10.0	18.3	10.0	10.0	10.0	-	-	-		
Avg. Monthly Total Activity - A	1028.5	1416.9	1249.1	842.3	1098.6	690.0	812.35	1070.1	1002.1	1441.0	665.6	1104.4

(A) Activities are given as Gross-Beta, Sr-90 or both in Radwaste Operations and Monitoring Monthly Reports.

SUMMARY OF LOW LEVEL WASTE CONTRIBUTOR'S MONTHLY AVERAGE VOLUMES(1)
(MILLIONS OF GALLONS)

	1970	1971 Gross-Beta	1971 Sr-90	1972	1973	1974	1975	1976	1977	1978 Gross-Beta	1978 Sr-90	1979
Area (MH234)	.59	.24	.16	.18	.11	.06	.07	.11	.05	.06	.10	.13
Area (MH114 - MH112)	-	-	.86	.62	.41	.38	.15	.50	.48	.39	.59	.68
MH112	2.50	1.36	.87	.43	.46	.49	.69	.69	.60	1.04	.90	.69
Bldg. 3503 - 3508	.68	.65	.80	1.02	1.01	.47	.26	.12	.12	.15	.24	.74
Bldg. 3025 - 3026	1.34	.47	.38	.39	.42	.22	.84	.29	.41	.26	.62	.38
Bldg. 3019	.37	.09	.08	.08	.09	.31	.77	.58	.16	.19	.21	.28
Bldg. 2531	1.00	.70	.87	.82	.56	.47	.71	.67	.31	.26	.27	.33
Bldg. 3525	.81	.42	.40	.78	.47	.04	.03	.03	.08	.12	.21	.33
Bldg. 2026	.13	.24	.22	.18	.14	.17	.12	.13	.12	.10	.10	.09
Tank Farm Drainage	-	-	-	.82	1.03	1.02	.79	.9	.96	1.07	.90	1.45
Bldg. 3505, 3517	.21	.10	.07	.02	.06	.01	.02	-	-	-	-	

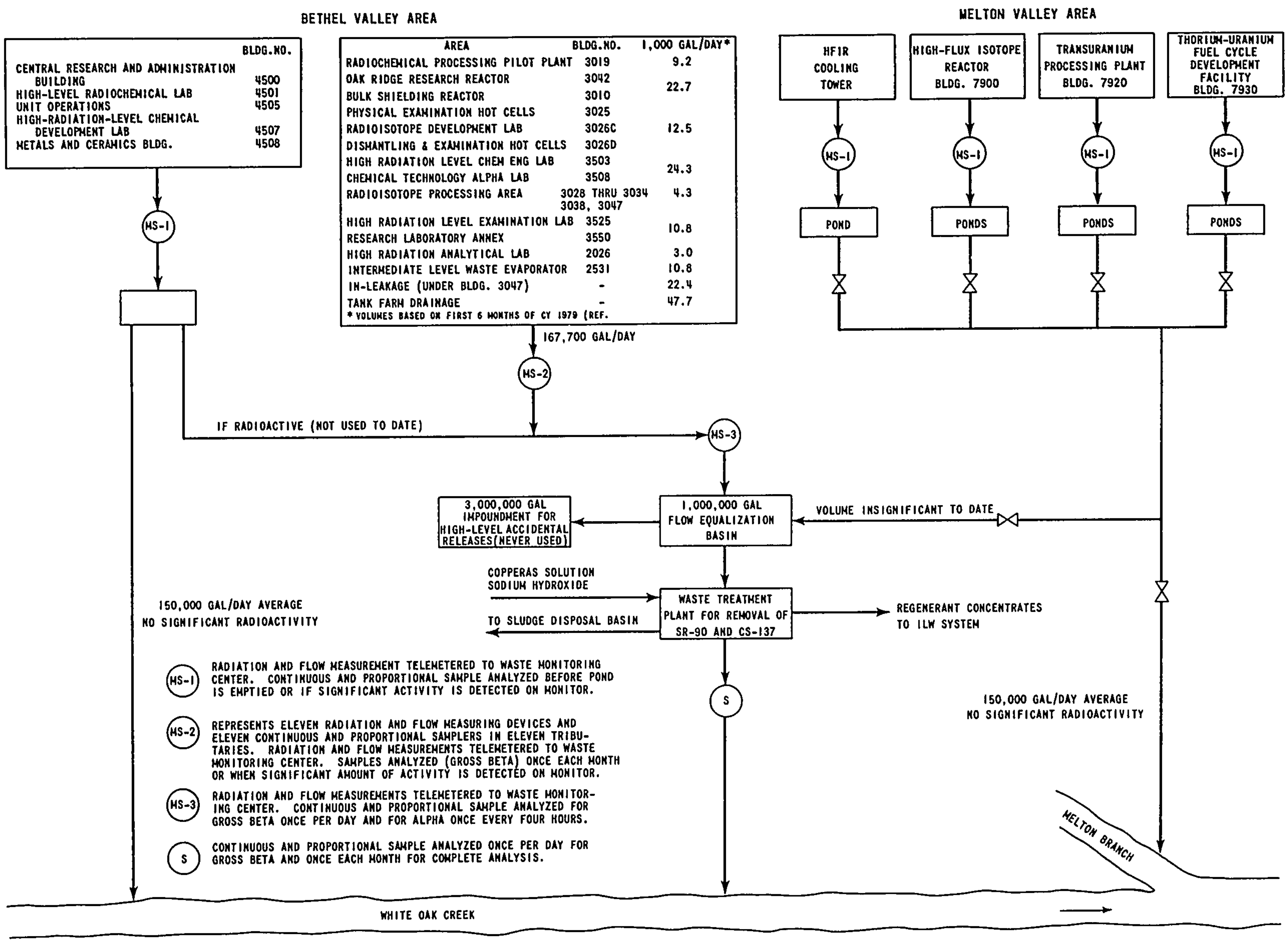

FIGURE 4.1-2
LOW LEVEL WASTE SYSTEM

TABLE 4.1-4

TYPICAL ANALYSIS OF ORNL LOW LEVEL WASTE(2)

Constituent	ppm	Constituent	ppm
Total Hardness	100-120	Dissolved CO_2	10
Calcium Hardness	60- 85	Bicarbonate	50-80
Total Alkalinity	80- 95	Carbonate	<1
Calcium	20- 30	Phosphate	0.89-3.3
Magnesium	2- 10	Sulfate	12
Sodium	25- 30	Fluoride	7
Uranium	<0.01	Nitrate	26
Copper	0.05	Chlorine	5
Aluminum	0.01	Total Solids	180
Silicon	2.6		
Iron	0.1		
Nickel	0.03	pH	7-8
Chromium	0.05	Gross Beta-Gamma	1.8×10^{-4} μCi/ml (0.68 μCi/gal)

The percent of the maximum permissible concentration (MPC) released to the Clinch River from 1975 through April 1979 is given in Figure 4.1-3A(4). This value is calculated using a dilution factor for the river. The MPC measured at the confluence of the White Oak Creek and the Clinch River is typically 30 to 50 times the calculated value. This is attributed to incomplete mixing at the sampling point. The main contaminants released are Sr-90, H-3, and I-131 with typical percentages of 70, 25, and less than 5 of the total activity released, respectively. The average monthly Curies of Sr-90 released for the period of 1965 through June 1979 is given in Figure 4.1-3B.

The monthly percent of the MPC as tritium (H-3) released to the Clinch River for the period of January 1970 through October 1978 is given in Table 4.1-5. The percent MPC has not been reported since October 1978. The monthly Curies of tritium released from December 1975 through April 1979 are given in Table 4.1-6.

4.1.2 Current Collection/Retention Practices

The waste streams flow into a 1 million gallon equalization basin which acts as a surge volume to equalize the flow to the treatment plant. Activities of the various streams entering the basin have ranged from 0.0014 to 1.44 μCi/gal during the period January 1970 through June 1979. The largest activities and volumes have generally been from the radioisotopes processing area and tank farm drainage. After mixing in the basin, the average annual activity has ranged from 0.14 to 0.32 μCi/gal. In the event of an accidental radioactivity release, the waste would be pumped to a 3 million gallon emergency pond. It has not been necessary to use this pond to date.

4.1.3 Current Treatment Practices

The current process waste treatment plant began operation on March 30, 1976. The treatment process, termed scavenging precipitator-ion exchange (SP-IX), has a decontamination factor (DF) of over 1,000 for Cs-137 and Sr-90. SP-IX replaced a soda-lime process which had a DF of 5 to 10 for the same radioisotopes. The success of the new process in minimizing activity discharged to White Oak Creek is clearly evident in Figure 4.1-4A. Activity

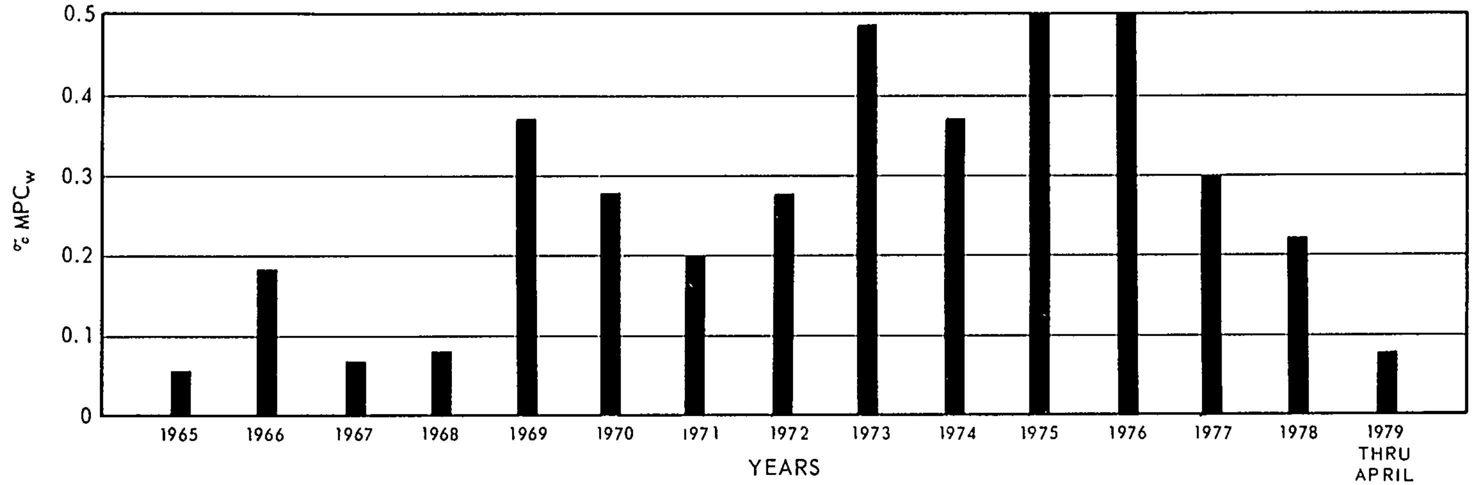

FIGURE 4.1-3A
CALCULATED PERCENT OF MPC IN THE CLINCH RIVER DUE TO ORNL DISCHARGES

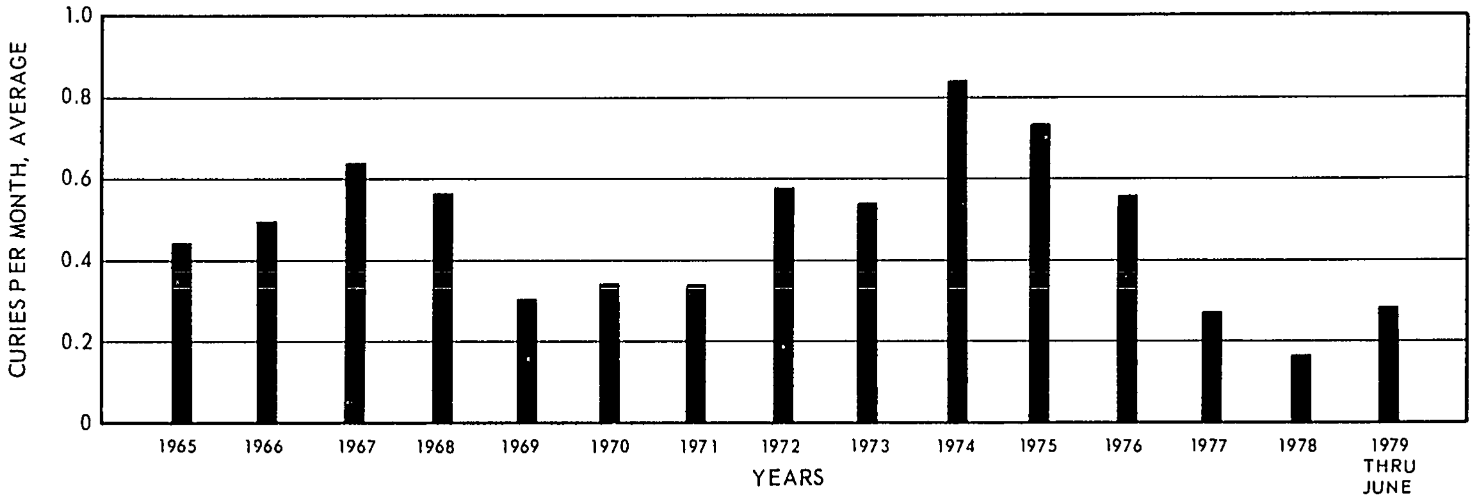

FIGURE 4.1-3B
TOTAL Sr-90 RELEASED TO WHITE OAK LAKE AS MEASURED AT SAMPLING STATIONS 3 AND 4

TABLE 4.1-5

TRITIUM (H-3) IN THE CLINCH RIVER
(MPC PERCENTAGE)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
January	19.0	19.5	.05	.06	.05	.20	.12	.04	.05	
February	15.0	18.9	.06	.12	.03	.07	.08	.08	.03	
March	18.5	21.3	.09	.08	.09	.06	.08	.15	.08	
April	17.8	-	.07	.14	.05	.04	.07	.04	.05	
May	26.2	-	.04	.14	.05	.04	.13	.02	.16	
June	19.7	22.4	.03	.035	.04	.03	.07	.03	.04	
July	14.5	.04	.03	.035	.01	.01	.05	.01	.04	
August	9.1	.02	.02	.021	.01	.01	.01	.01	.03	
September	15.4	.02	.01	.015	.01	.02	.01	.07	.02	
October	12.3	.02	.05	.028	.02	.07	.05	.06	.04	
November	18.1	.02	.05	.14	.05	.10	.08	.04		
December	21.1	.07	.04	.096	.11	.06	.08	.02		

TABLE 4.1-6

TRITIUM (H-3) RELEASED TO THE CLINCH RIVER
(CURIES)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
January							1852	570	920	1050
February							880	568	530	1096
March							664	582	2250	621
April							688	1100	440	683
May							584	234	590	*
June							354	337	434	*
July							435	102	434	
August							131	84	549	
September							115	658	166	
October							394	409	110	
November							440	898	520	
December						631	923	703	1030	

*Not Available

declined from 0.27 Ci/mo in 1975 to 0.0012 Ci/mo for the first six months of 1979. Waste volumes over the same period are shown in Figure 4.1-4B.

A flow diagram of the SP-IX process is shown in Figure 4.1-5(2). The process consists of three basic operations: precipitation, filtration, and ion exchange. Half of the activity of the entering stream is removed in the form of a sludge in the precipitator-clarifier. The water decant flows through filters and an ion exchange resin before being discharged to the White Oak Creek.

The SP-IX process produces the following outlet streams:

- Treated process water discharged to White Oak Creek (activity 1.5 nCi/gal in the first 6 months of CY 1979).

- Sludge from the precipitator-clarifier.

- Evaporator bottoms from evaporation of the nitric acid resin regeneration solutions.

- Condensate from evaporation (dilute nitric acid).

- Condensate from evaporator steam coils.

4.1.4 Current Disposal Practices

The treated SP-IX process water is discharged from the ion exchange column to a clearwell prior to discharge to the White Oak Creek. A low range gamma detector monitors the effluent from the ion exchange columns and actuates an alarm if the radioactivity exceeds a predetermined level. The treated water is also neutralized with sulfuric acid prior to discharge to the creek.

Radioactive sludge from the new treatment plant is disposed of in a 219,000 gal basin located in Burial Ground 5 in Melton Valley. The sludge, generated as a 2 to 4 percent by weight slurry in the precipitator-clarifier treatment, accumulates in an agitated tank and is periodically pumped to the basin where

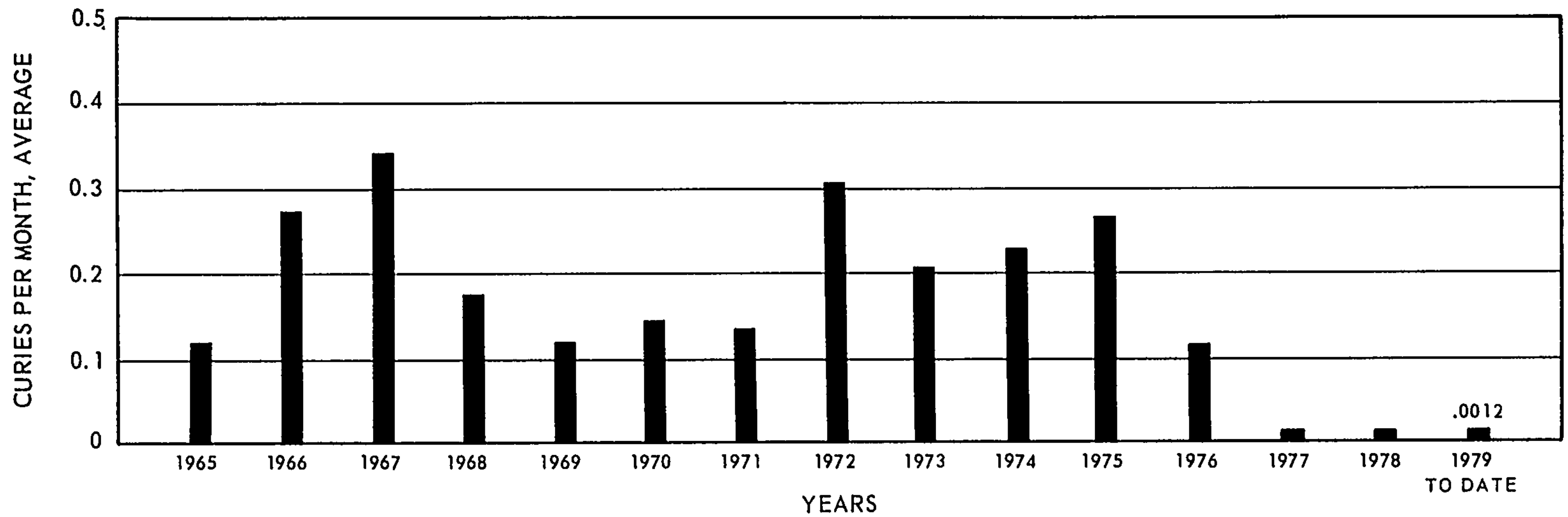

FIGURE 4.1-4A
SR-90 DISCHARGE IN PROCESS WASTE TO WHITE OAK CREEK

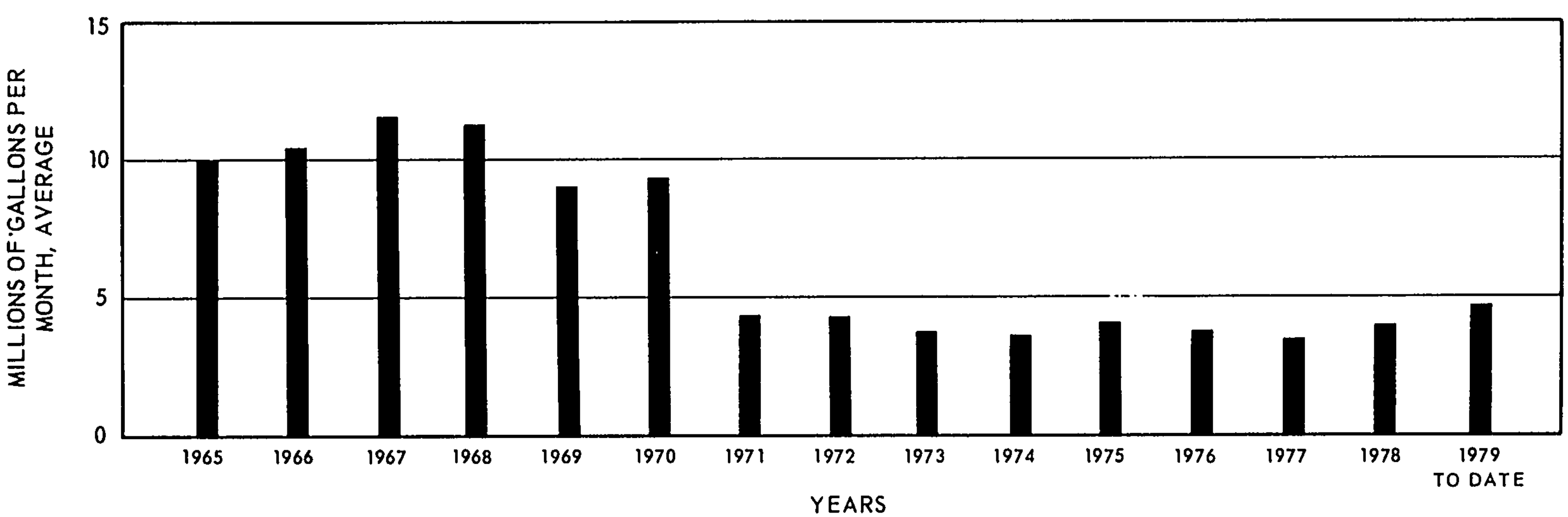

FIGURE 4.1-4B
PROCESS WASTE VOLUMES

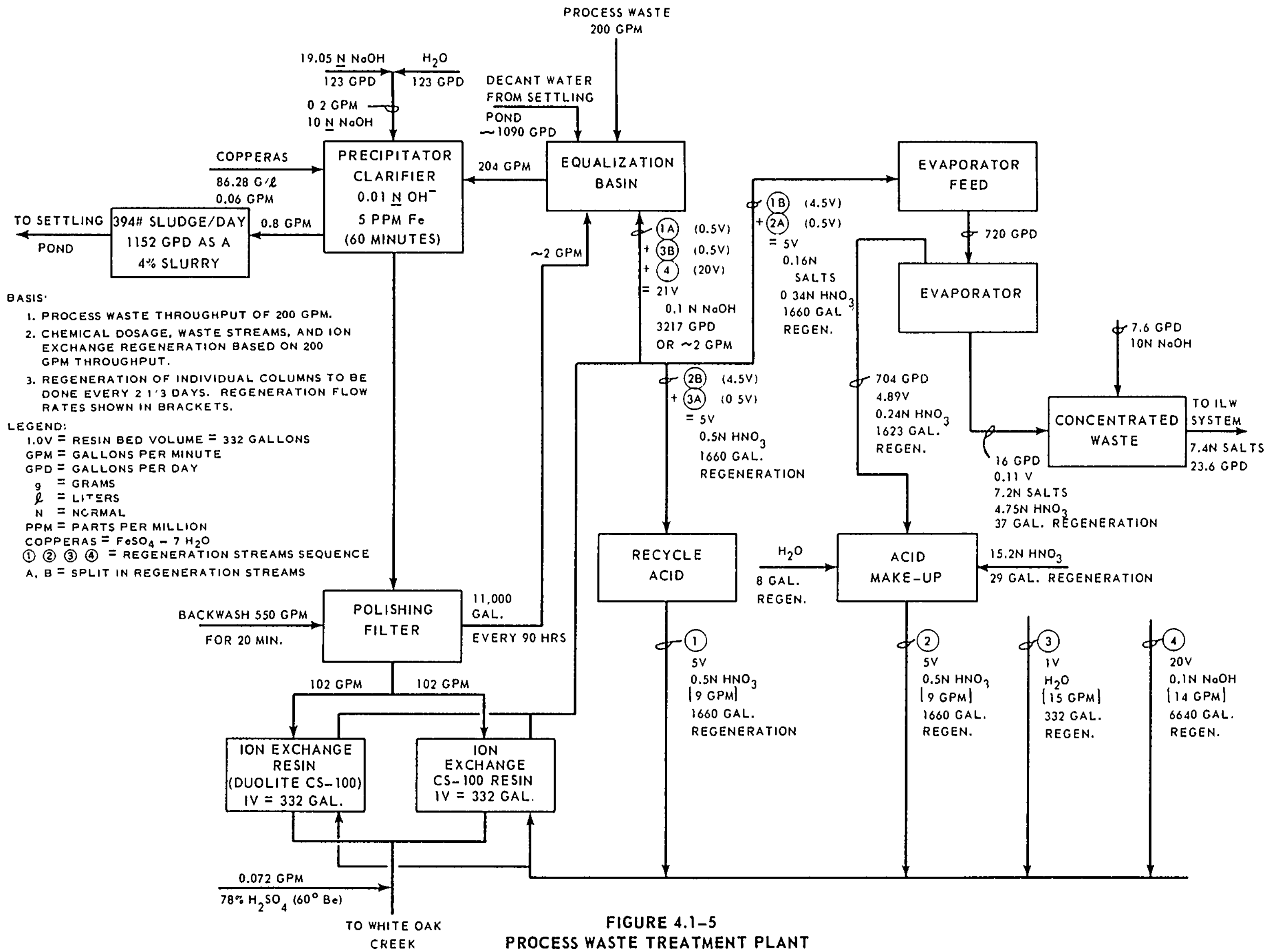

FIGURE 4.1-5
PROCESS WASTE TREATMENT PLANT
PROCESS SCHEMATIC CHEMICAL FLOWSHEET

the sludge settles and accumulates. The supernate is pumped back to the equalization basin. The estimated remaining life of the polyvinyl chloride lined (30 mil) sludge basin is 7 yr, after which it will be completely dewatered, backfilled, and protected from surface water. Space is available at the same site for additional sludge disposal basins.

Evaporator bottoms from the resin regenerant solution are neutralized with sodium hydroxide and pumped to the OR-ILW system. The diluted nitric acid condensate from the evaporator is collected in an acid make-up tank and recycled through the regeneration process.

The condensate from the evaporator steam coils is continuously monitored prior to discharge to White Oak Creek. In the event of a coil leak, the condensate can be diverted back through the LLW treatment plant.

4.1.5. Current Monitoring/Control Practices(5)

Seventeen manholes in the LLW system are liquid effluent monitoring and collection stations for groups of ORNL buildings. One is located at the inlet to the equalization basin where all tributaries join, and the rest are in the main tributaries of the system. Monitoring cabinets with no control functions are located nearby and service each of these manholes (Figure 4.1-6). The effluent is continuously measured for alpha and beta-gamma radioactivity and stream flowrate. Specific manhole designations, inlet sources, and type of radiation monitor are shown in Figure 4.1-7. All data is telemetered to the Control Complex 3105 for alarm and recording. The automatic diversion valving has been disabled. A typical manhole installation is shown in Figure 4.1-8.

Abnormal volumes or activities in the system can be identified from the data from the monitoring stations. Instrumentation at the Control Complex directs the operator to the general area where the discharges occur, and he notifies the building responsible for the release to take corrective action.

A low range gamma detector monitors the effluent prior to discharge to the White Oak Creek. If the activity exceeds a predetermined level, an alarm is sounded, and discharge is discontinued until corrective action is taken.

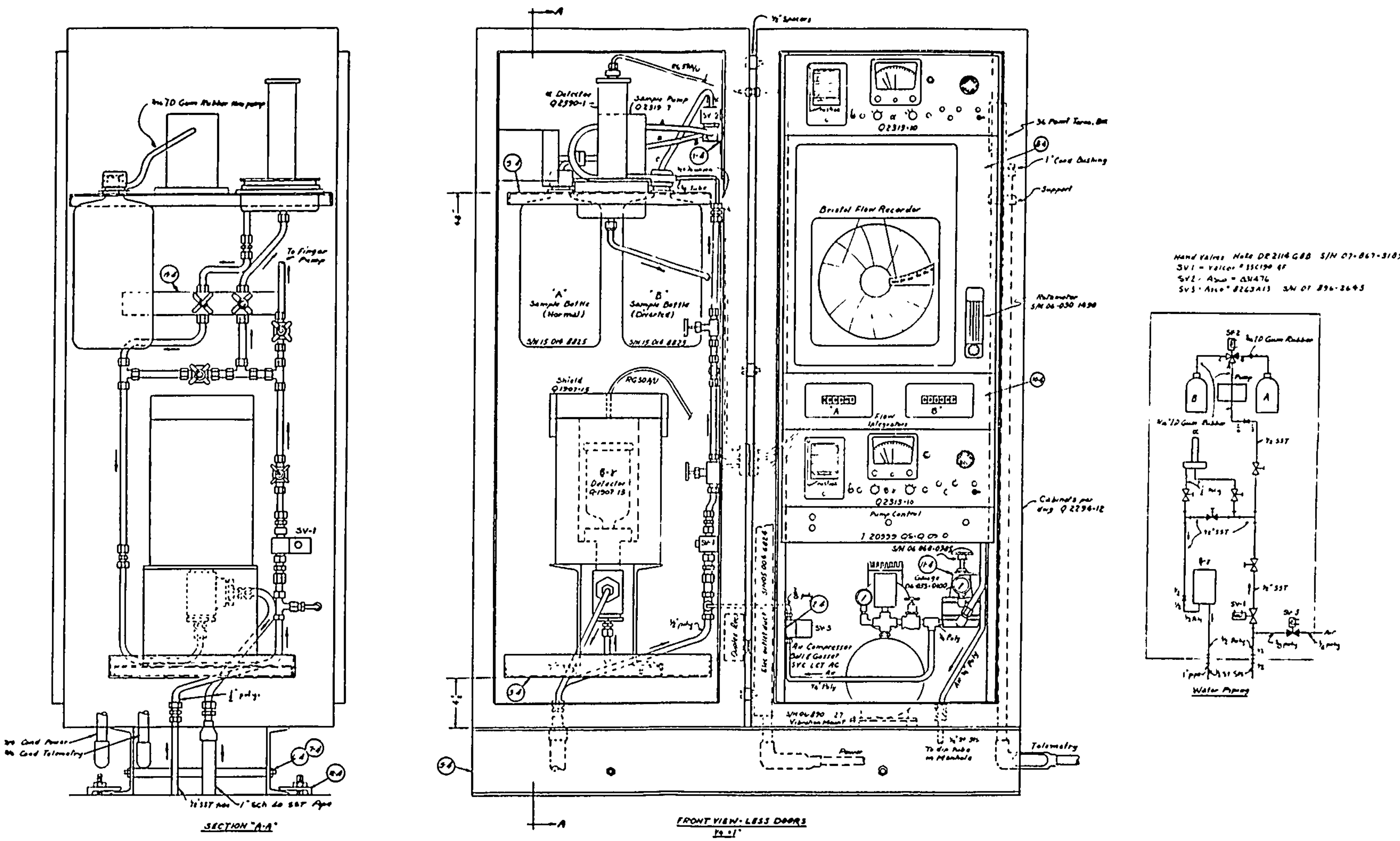

FIGURE 4.1-6
MONITORING CABINET SERVING MANHOLE COLLECTION STATION

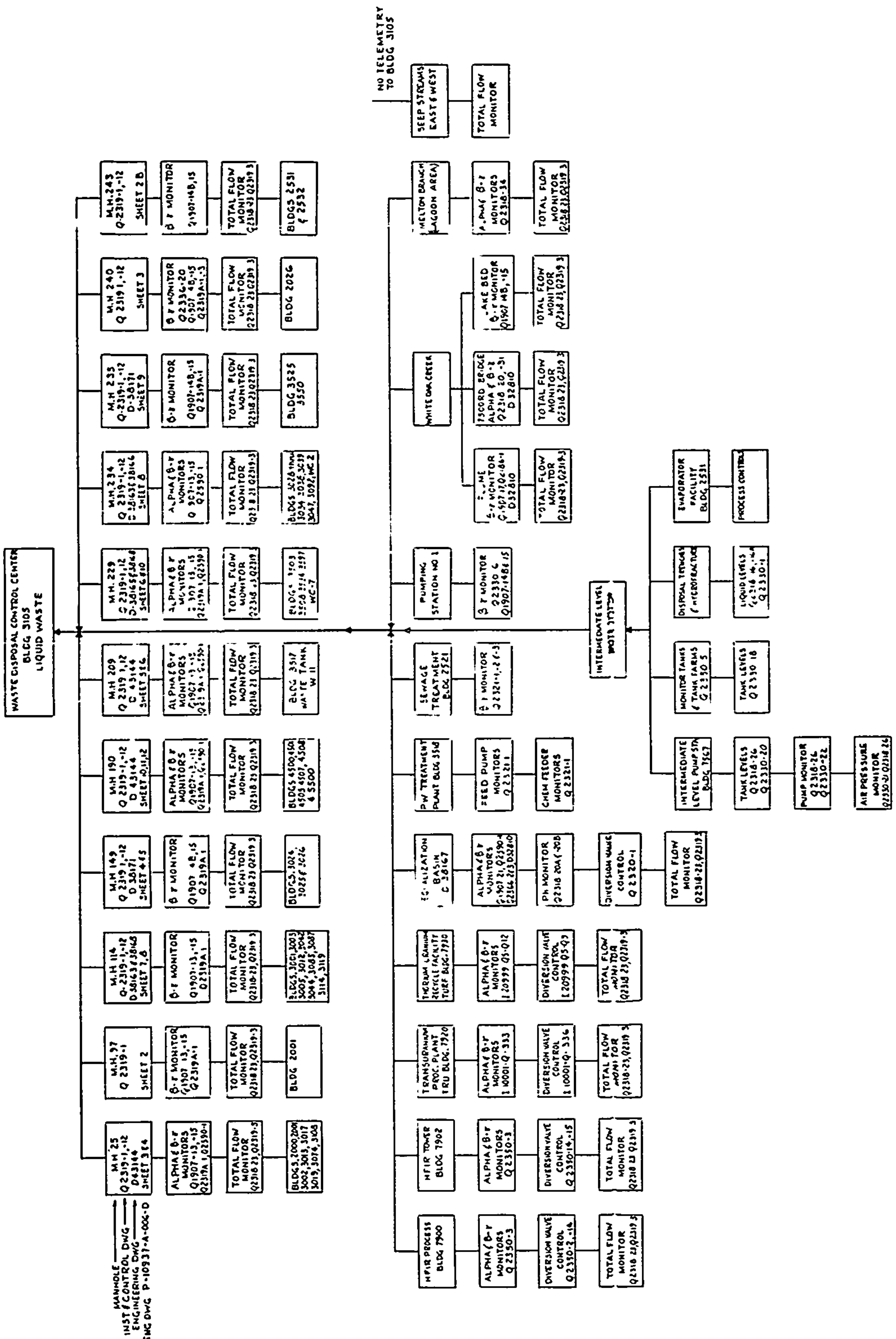

FIGURE 4.1-7
DRAWING INDEX
PROCESS WASTE WATER
WASTE DISPOSAL CONTROL CENTER

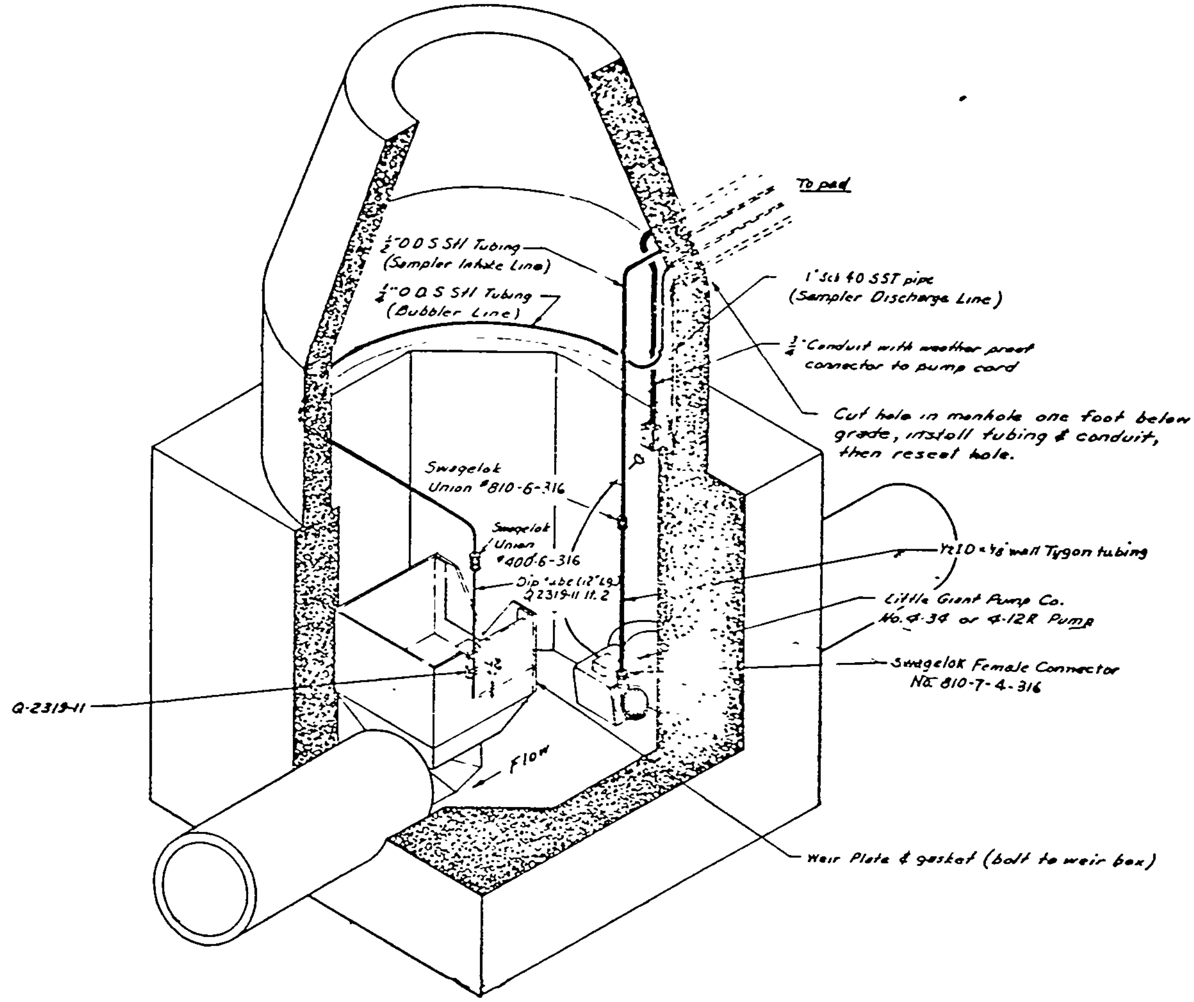

FIGURE 4.1–8
TYPICAL MANHOLE WITH WEIR BOX INSTALLATION

For process control, Geiger tube-type radiation sensors on the ion-exchange columns in the Water Treatment Building monitor the accumulation of radioactive contaminants on the resin bed. The condition of the column in service can thus be determined, and regeneration can be initiated before breakthrough occurs. A low-range gamma detector monitors the effluent stream from the ion-exchange columns to the clearwell. This is a backup device for the column detectors and indicates by alarm that radioactivity breakthrough has occurred.

For personnel, a beta-gamma monitor and an alpha monitor are located at the exit of the ion-exchange room. These devices check shoes, hands, and clothing for possible radioactive contamination. A beta-gamma constant air monitor and a monitron are located inside the ion-exchange room.

4.1.6 Recommendations/Conclusions

- The majority of the current total discharge of activity to the biosphere from ORNL originates as runoff and seepage from the burial grounds. Burial site studies have been continuing to determine acceptable methods of reducing these releases. Improvements have been made at the burial grounds including installation of surface seals and ground and surface water diversions. Based on these studies and improvements, a cost/benefit analysis should be performed to determine the most favorable interim and long range course of action.

- The tank farm drainage is the largest source of volume and activity to the waste processing system. This situation should be reviewed to assess the feasibility of reducing it, thereby significantly lowering the volume processed by the system.

- Inputs to the low level waste treatment facility should be reviewed to determine if any contain activity levels low enough to be discharged directly. This would reduce the burden on the treatment system and provide increased capability for future operations.

- The use of open basins for sludge disposal should be reviewed for compliance with DOE Manual Chapter 0511. Alternatives to using open basins for sludge disposal should be reviewed as a means of reducing uncontrolled releases of radioactivity.

- The current monitoring and sampling equipment for the LLW system is old and requires high maintenance. Even though it accomplishes its basic function, it is recommended that a study be performed to determine the cost/benefit of equipment changeout. A prudent renovation scheme integrated to the computerized data acquisition system would provide long term benefits.

4.2 INTERMEDIATE LEVEL WASTE

The OR-ILW system at ORNL collects, neutralizes, concentrates, and stores radioactive liquids. The system is designed to handle wastes with radioactive concentrations as high as 20 Ci/gal(3).

The system originally consisted of extensive underground piping that was used to collect OR-ILW from various ORNL facilities and transport the waste to a central storage tank farm (six 170,000 gal "gunite" storage tanks). In 1949, ORNL waste operations installed a pot-type evaporator to concentrate the OR-ILW. The evaporator bottoms (concentrate) were stored in the central tank farms, and the evaporator distillate was discharged to White Oak Creek. In 1954, the pot-type evaporator system was discontinued, and solar evaporation and ion exchange on native shale became the process techniques used. In 1965, the currently operating 10 gpm evaporator was placed in service. Concentrates are disposed of in a hydrofractured formation; distillate is treated as LLW. A backup evaporator, identical to the one in operation, is being installed(5).

4.2.1 Sources(5)

The sources of OR-ILW are "hot" sinks and drains, radiochemical pilot plants, and nuclear test reactors in the Bethel and Melton Valley facilities.

The waste volume currently varies from 1.3 to 1.5 million gal/yr. Table 4.2-1 presents a listing of the major contributors and yearly volumes of OR-ILW treated(1); this data are summaries from ORNL Liquid and Gas Monthly Operations reports. Appendix E presents the yearly OR-ILW waste source volumes by month.

The major radionuclides present are Sr-90, Cs-137, Ru-106, Co-60, and rare earths. Current activities average 0.03 Ci/gal. Total annual Curie content is approximately 3.5×10^4 to 5.5×10^4 beta-gamma. Total annual alpha activity also varies but recently has been averaging 80 Ci (mostly Cm-244). OR-ILW chemical and radionuclide source content are not routinely documented.

4.2.2 Current Collection/Retention Practices(5)

Waste solutions are collected in tanks near each source. The collection tanks vary in capacity from 500 to 15,000 gal depending on the requirements of each source. Nineteen of the 23 collection tanks are located in Bethel Valley; the remaining four tanks are located in Melton Valley and serve the HFIR, TRU processing plant, and TURF. Table 4.2-2 lists the OR-ILW waste collection tanks currently in operation; Figure 4.2-1 shows the locations of the collection tanks. Inactive OR-ILW tanks are listed in Table 4.2-3 along with reasons for their being out of service. All of these tanks except W-19 and W-20 are scheduled for decommissioning under the Surplus Facilities Management Program.

Waste accumulates in each tank to an administrative limit set by the operations staff (Example: Tank W1-A capacity is 4,000 gal; operating volume is 3,000 gal). In the event of tank rupture, the contents would be drained to a sump located on each collection tank pad, as shown in Figure 4.2-2. Recently installed tanks have concrete cubicles for retention dikes.

Underground transfer lines connect the source collection tanks to the Bethel Valley collection headers. As shown in Figure 4.2-3, the collection headers drain to two evaporator service tanks W-21 and W-22. Existing gunite tanks can be valved into service in the event of emergency tank capacity limitations. Transfer lines pipe waste to two evaporators in Building 2531. Evaporator distillate is piped to the low level waste collection ponds

TABLE 4.2-1(1)

SUMMARY OF INTERMEDIATE LEVEL WASTE
CONTRIBUTOR'S ANNUAL VOLUMES
(THOUSANDS OF GALLONS)

Waste Source	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979 6 Month Total
Building 3019	394	277.3	290.05	330.7	220.5	245.7	246.1	183.6	106.0	57.17
ORR & BSR	354	306.25	268.20	279.6	291.4	285.3	257.9	172.6	190.9	75.62
HFIR	234	348.75	275.90	234.3	214.3	272.9	213.0	202.0	226.1	127.13
FPDL	133	260.10	283.90	266.1	214.7	115.6	84.0	93.7	55.8	71.61
4500 Complex	173	197.10	125.50	181.6	68.3	97.0	143.9	118.4	195.0	64.33
Radioisotopes Process. Area	190	332.0	339.05	207.7	105.2	82.3	129.8	99.5	118.6	62.38
Transuranium Process. Area	10	12.0	56.10	52.1	29.0	39.5	37.4	40.3	18.8	12.3
Building 3026D	85	121.0								
Building 3025	10									
Molten Salt Reactor Exp.	13									
Nuclear Safety Pilot Plant	10									
Building 3508	32	10.0								
Building 3508 & 3503			9.9							
Building 3505 Canal							35.6			
Acc. Surface Drain. Shale Fract.								17.0		
TOTAL OF ABOVE	1638	1864.5	1648.6	1552.1	1143.4	1138.3	1147.7	927.1	911.2	470.54
TOTAL ILW VOLUME REPORTED	2552	2725	2506	2041	1632	1544	1441	1354	1328	790

TABLE 4.2-2(5)

ACTIVE ILW COLLECTION TANKS

Tank No.	Building Served	Capacity (Gallons)	Operating Volume[a] (Gallons)	Diameter	Length[b]
W1-A	2026 & 3019	4,000	3,000	7'-6"	13'-6" H
WC-2	3028	1,000	700	5'-6"	7'-4" V
WC-3	3025	1,000	700	5'-6"	7'-4" V
WC-4	3026	1,700	1,200	7'-0"	7'-0" V
WC-5	3503	1,000	750	5'-6"	7'-4" V
WC-6	3508	500	350	4'-6"	5'-8" V
WC-7	3504	1,100	750	5'-4"	7'-5" V
WC-8	3503	1,000	750	5'-6"	7'-4" V
WC-9	3503	2,150	1,550	7'-0"	10'-9" V
WC-10	Isotope Area & 3039 Stack	2,300	1,650	6'-4"	10'-4" H
WC-11	4501	4,600	2,900	7'-8"	13'-8" H
WC-12	4505	1,000	700	5'-6"	7'-4" V
WC-13	4500N	1,000	700	5'-6"	7'-4" V
WC-14	4501	1,000	700	5'-6"	7'-4" V
WC-19	3042	2,100	1,500	6'-1"	9'-8" H
WC-20	7920 & 7930	10,000	7,000	10'-0"	19'-6" H
W-12	3525	700	400	4'-0"	5'-4" V
W-16	3026D	1,000	700	5'-6"	7'-4" V
W-17	3026C	1,000	700	5'-6"	7'-4" V
W-18	3026C	1,000	700	5'-6"	7'-4" V
T-1	7900	15,000	10,500	10'-0"	27'-6" H
T-2	7920	15,000	10,500	10'-0"	27'-6" H
HFIR	7900	13,000	9,100	8'-0"	35'-0" H

[a] Normal maximum volume of waste permitted.

[b] Vertical tanks are designated by V and horizontal tanks by H.

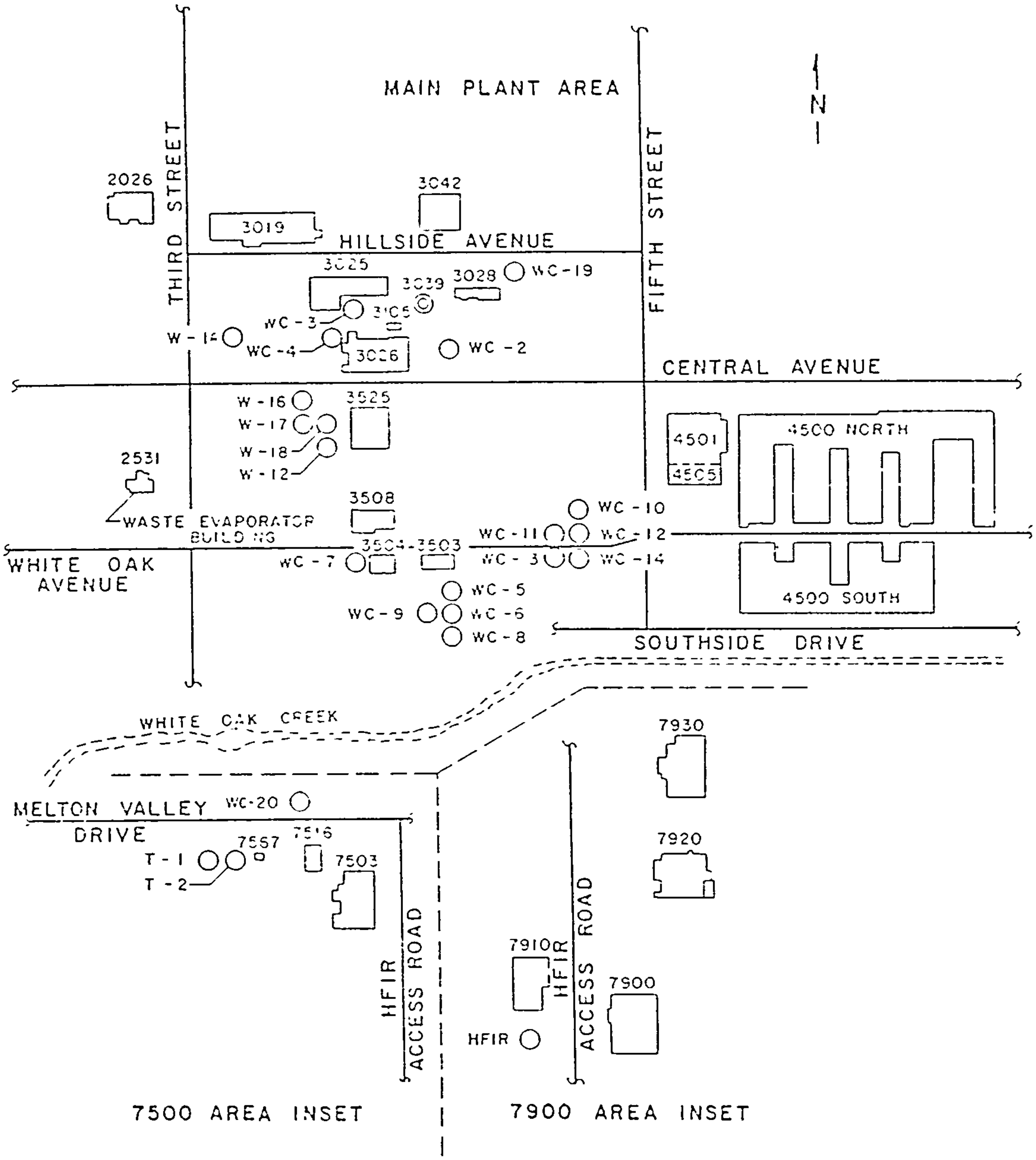

FIGURE 4.2-1
MAP SHOWING THE LOCATION OF THE ILW COLLECTION TANKS

TABLE 4.2-3

INACTIVE ILW COLLECTION TANKS(5)

Tank No.	Description & Location	Remarks
W-1 & W-2	Concrete tanks located in north tank farm.	Out of service because of leaks. Highly contaminated internally.
W-3 & W-4	Concrete tanks located in north tank farm.	Tanks do not leak, but collect surface water. Highly contaminated internally.
W-11	Gunite sprayed tank used for Building 3550 located near south tank farm.	Removed from service because of leaks. Highly contaminated internally.
W-13, W-14, & W-15	Stainless steel tanks located in north tank farm.	Out of service since 1958. Conflicting reports exist as to their contents. All are highly contaminated.
W-19 & W-20	2250 gal stainless steel tanks located near south tank farm were used for PPDL wastes.	The tanks do not leak, but out of service since 1960. Perhaps contain some liquid and sludge. Highly contaminated internally.
WC-1	2000 gal stainless steel underground tank located west of Bldg. 3037.	Abandonded in 1968 because of leaking discharge line. Contains Curie quantities of Co-60, Cs-137, and Sr-90 residual contamination.
WC-15 & WC-17	1000 gal stainless steel underground tanks used for 4500 area. Located south of Bldg. 3500.	Removed from service because of leaks. High contaminated internally.
Th-1, Th-2, & Th-3	Stainless steel tanks located south of Bldg. 3503. Were used for wastes from Fission Product Development Laboratory.	Tanks are empty, but are contaminated internally with thorium.
Th-4	Gunite sprayed concrete tank located southwest of Bldg. 3500.	The tank is out of service, but, at present, contains sludge. The sludge will be removed as a part of the proposed campaign to remove sludge from six gunite tanks in the south tank farm.

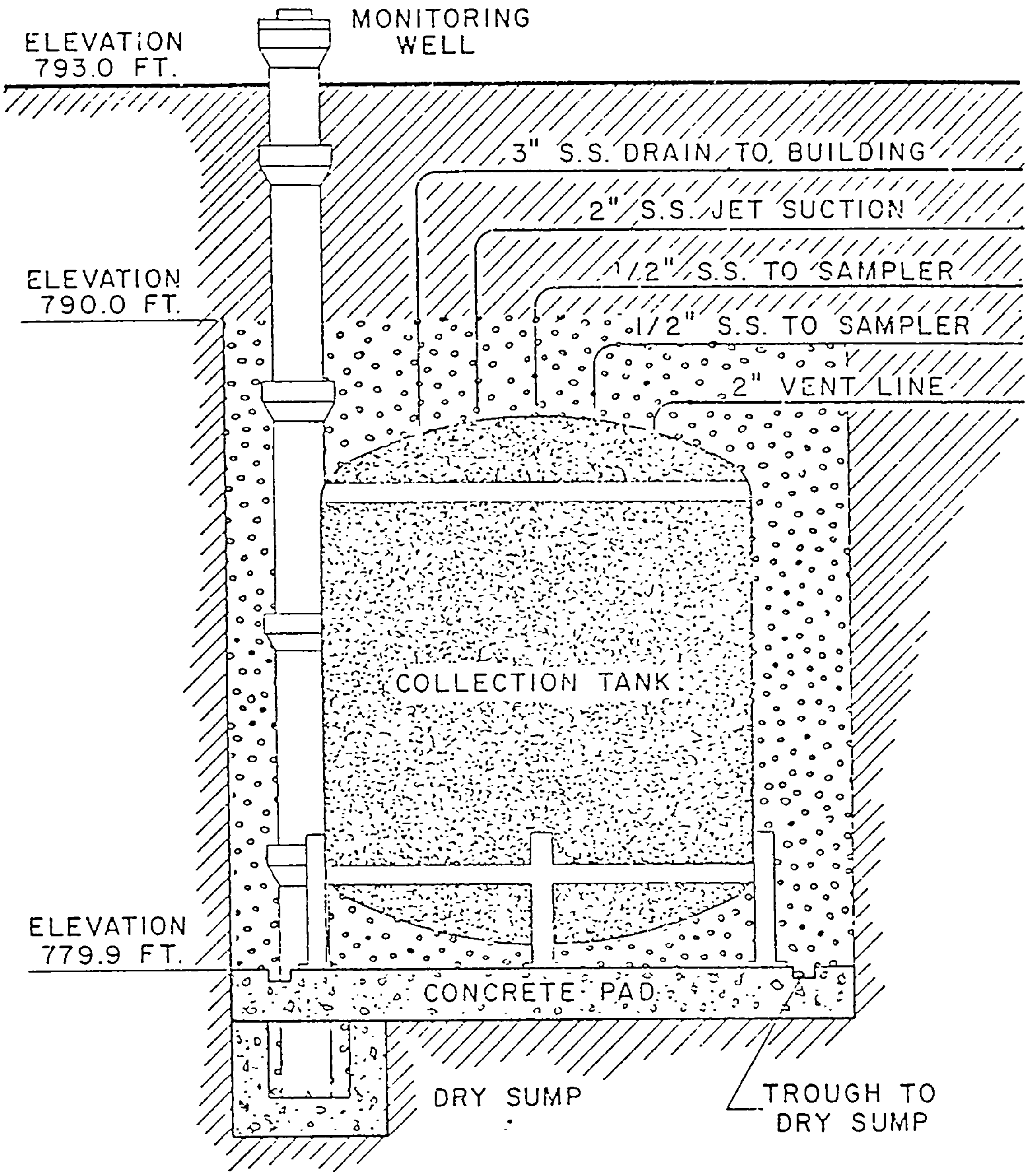

FIGURE 4.2-2
TYPICAL COLLECTION TANK INSTALLATION IN BETHEL VALLEY

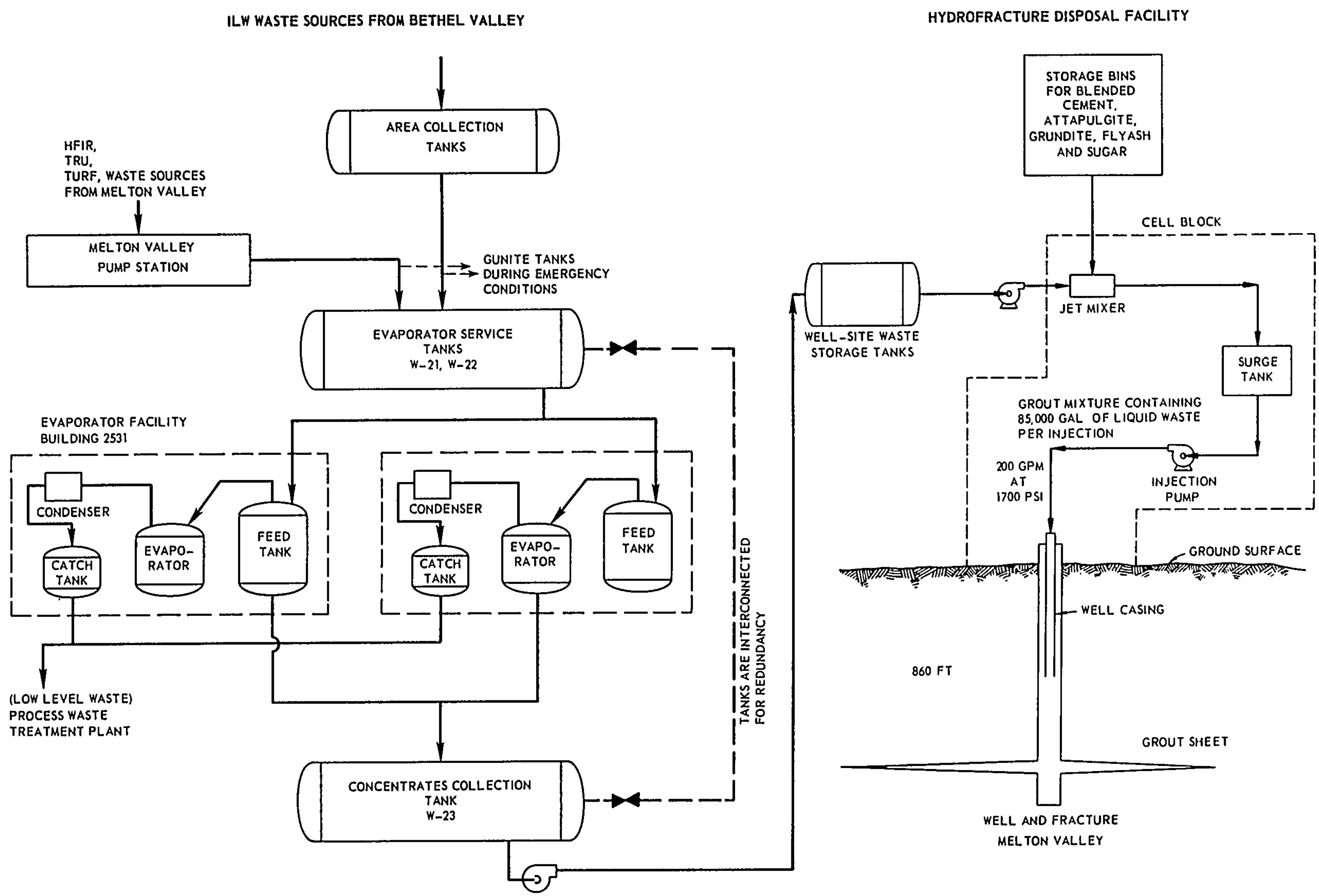

FIGURE 4.2-3
INTERMEDIATE LEVEL WASTE SYSTEM

(equalization basin), and evaporator concentrates are piped to a concentrates collection tank (W-23). If additional storage capacity is required, either tank W-21 or W-22 will be kept empty for use during emergency conditions such as a leak. Concentrates are pumped to the Melton Valley hydrofracture site storage tanks for disposal.

4.2.3 Current Treatment Practices(5)

Two 600 gal/hr (10 gpm) evaporators are located in Building 2531. These evaporators are single vessel, pot-type, natural circulation evaporators. Steam heats seven seamless coils located in the bottom 3 ft of the evaporator. If cooling is required in the vessel, water can be injected in the coils for proper temperature control. Each of the evaporator vessels have anti-foam injection capability and remote internal decontamination spray headers. Decontamination is possible because of impingement trays installed in the top head of the vessel. Figure 4.2-4 is a cutaway section view of the waste evaporator vessel.

The evaporator is operated on a batch feed system. The vessel is filled with waste and additional feed is forwarded to the vessel as boil-off occurs. When the vessel operating level is filled with concentrated waste based on a density probe sample, the evaporation process is terminated, and the waste is batch fed to the concentrates tank.

The evaporator is controlled locally within Building 2531 with a malfunction alarm in the Control Complex in Building 3105.

Evaporator distillates are collected in a surge catch tank. Following radiation monitoring, the distillate is treated in the low level waste facility.

4.2.4 Current Disposal Practices(6)

Intermediate level waste concentrates are disposed in a hydrofracture of a shale formation approximately 1,000 ft underground. Waste is pumped from the concentrate tanks to four waste storage tanks at the Melton Valley hydrofracture

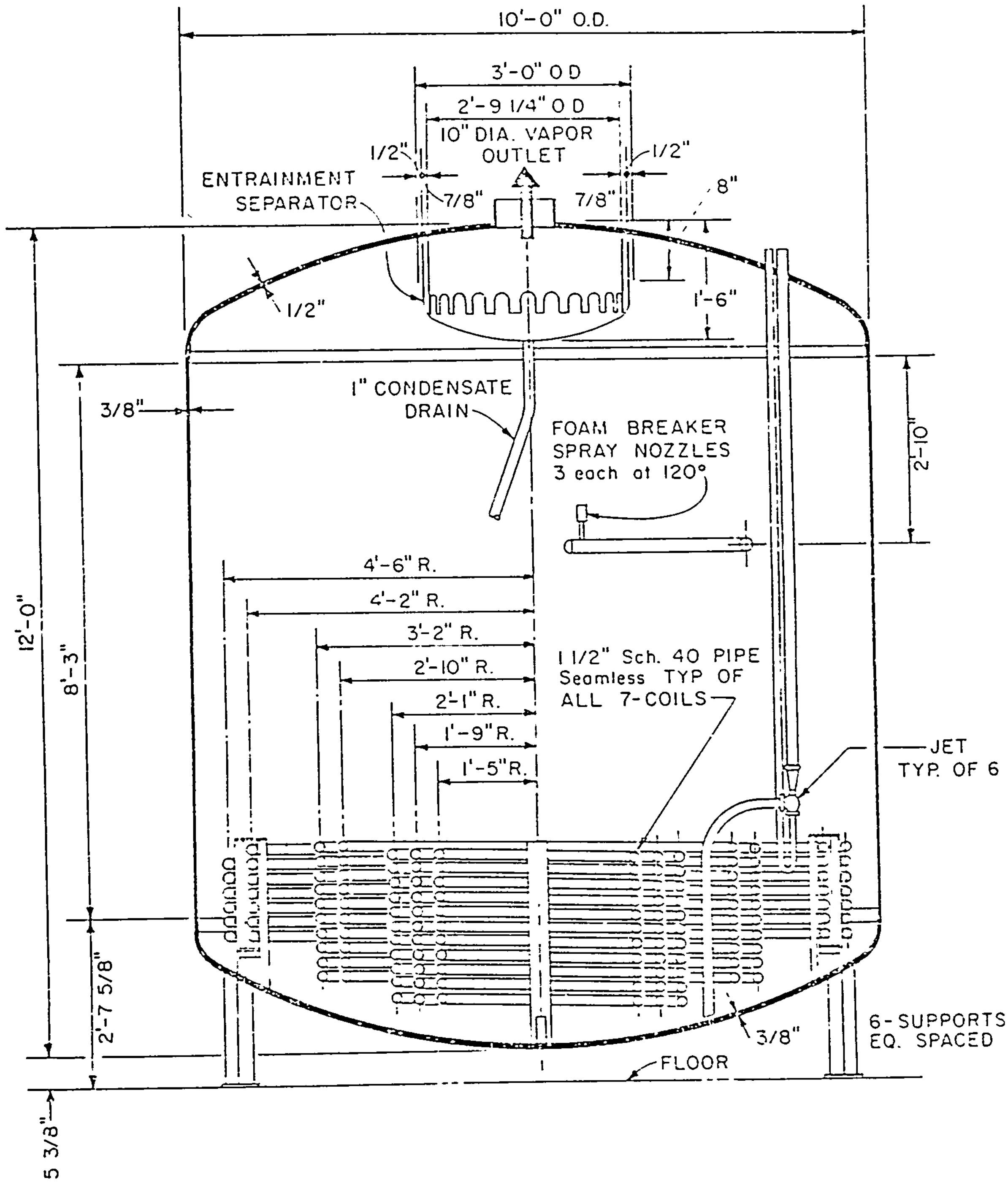

FIGURE 4.2-4
SECTION-WASTE EVAPORATOR

facility. At the facility, the waste is mixed with a clay-cement grout, and high pressure pumps inject the waste/grout mixture into the hydrofracture at 2,500 psi at a rate of 180 to 200 gpm. An aerial view of this facility is shown in Figure 4.2-5.

The requirements of the hydrofracture disposal process set stringent criteria for the grout properties. The grout must be: 1) compatible with the waste solutions, 2) pumpable for extended times (~24 hr), and 3) retain virtually all the associated water when solidified. Another desirable characteristic is a relatively low leach rate.

The blend of solids that produces grouts with these properties contains the following: 1) cement, 2) fly ash to retain strontium, 3) attapulgite clay to retain excess water, 4) a second clay to retain cesium, and 5) a retarder to delay the setting of the grout. The proportions of the different ingredients can be adjusted to allow for considerable variation in the composition or concentration of the waste solution being injected. A typical recent composition follows.

TABLE 4.2-4

COMPOSITION OF GROUT MIX

Ingredient	Weight Percent
Cement (Type 1)	38.5
Fly Ash	38.5
Attapulgite	15.4
Pottery Clay	7.7
Retarder (Sugar)	0.05

Until recently, the clay that has been used to retain cesium in the grout has been grundite (an illitic clay). Recent tests have shown, however, that several other additives have a much greater affinity for cesium than does

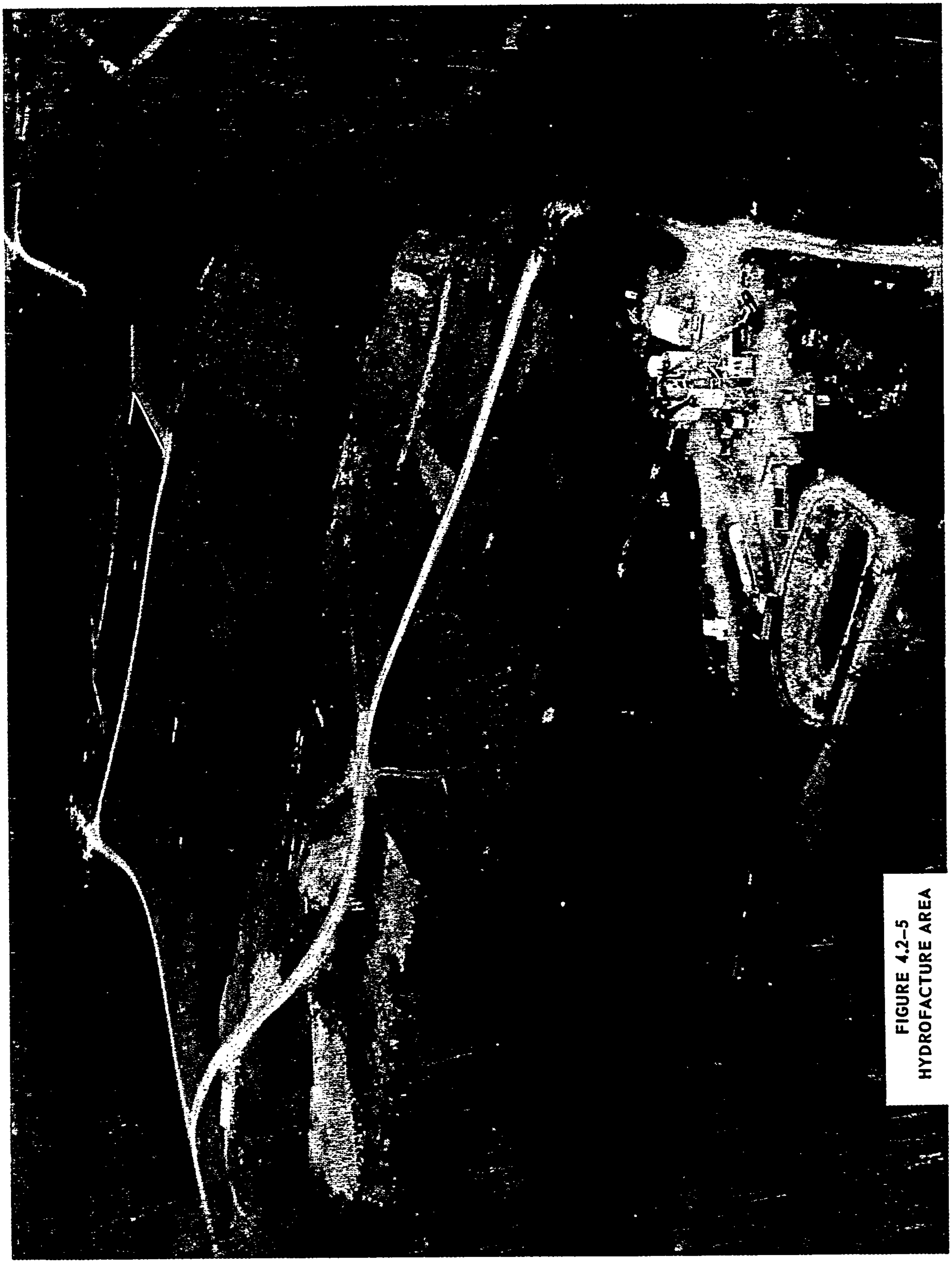

FIGURE 4.2-5
HYDROFACTURE AREA

grundite. Pottery clay, such as American Art Clay Company's Indian red clay, performs well, but the best material found to date is local Conasauga shale.

The dry solids mix is usually blended with liquid waste solution at a solids-to-liquid ratio of between 6 and 9 lb/gal. The resultant grout has a density of about 12 lb/gal and an apparent viscosity of about 40 cp. The volume ratio of grout-to-liquid waste is approximately 1.4.

For the injections, the facility has a 10 inch diameter casing down to 100 ft, 6 inch diameter piping down to 1,000 ft, and a 2 inch diameter injection pipe to 1,000 ft.

Each shale fracture operation uses a slurry "oil well" process. First, a hole is cut in the 6 inch diameter pipe with a sand/water jet. After cutting through the pipe, the shale formation is fractured by pressurizing the well with water. The existing well contains 18 waste injections which have been pumped into five fractures at 10 ft intervals. A system of observation wells determines the orientation of the grout sheet, and a network of benchmarks is used to measure uplift.

4.2.5 Current Monitoring/Control Practices(5,7)

All OR-ILW collection tanks are equipped with liquid level detectors with readouts and alarms telemetered to the Control Complex. Controls for pumping down the tanks are located near them. Operating practices require the tanks to be pumped down at the 60 percent full level. Where necessary, monitoring for explosive mixtures is provided.

For the evaporator service tanks (W-21, W-22, and W-23), critical parameters are annunciated in the service tank control room and/or the evaporator tank control room. The annunciators are also telemetered to the Control Complex to to allow unattended operation. The tanks are equipped with liquid level indicators, temperature and specific gravity measuring devices, air spargers, sampling devices, and combustible gas analyzers.

Local contamination level indicators, beta-gamma constant air monitors and alarms are provided in the tank control room and the evaporator control room. There is also a remote alarm in the Control Complex.

All the critical parameters for the evaporators are monitored by annunciators which are telemetered to the Control Complex. Evaporator instrumentation includes electrical conducting probes to measure the foam level above the liquid, liquid level indicators, a pressure differential device to measure specific gravity, and temperature measuring devices.

To guard against the release of high activity condensate, a heel of condensate in the catch tank is continuously monitored for radioactivity. The tanks are provided with specific gravity, liquid level, and temperature measuring devices. Provision is made for sampling.

The evaporator feed tank has instrumentation to continuously measure liquid level, specific gravity, and temperature.

The off-gas scrubber system instrumentation consists of liquid level, temperature, and specific gravity measurements in the surge tanks and differential pressure measurements across the scrubber.

Pressure drops across the filter pit units and the local inlet and outlet filters are monitored.

Under certain conditions, the evaporator building will operate with controlled ventilation in accordance with ORNL containment criteria through use of a containment interlock circuit. This control is necessary to prevent the escape of airborne activity from the facility to the environment, to prevent cross contamination of areas within the building, and to filter the air before it is released to the central cell ventilation system. There are no bypasses which can prevent the containment interlock from being activated in the event of an activity release or fire.

Air throughout the Evaporator and Annex Buildings is monitored for airborne radioactive particles by beta-gamma constant air monitors located in the operating area, sample room, crane bay, and annex sample room. Background levels of beta-gamma radiation are monitored in the operating area. Steam condensate and process condensate are monitored for beta-gamma radiation before release from the building. The air monitors are connected to an alarm panel in the evaporator control room.

4.2.6 Recommendations/Conclusions

- Monthly Curie content inventories are not reported for contributors to the OR-ILW system. An administrative procedure should be developed to record the source and composition of radwaste generated at each building thus preparing the waste management staff for the type of waste chemicals to be processed. The generator will also become more accountable for the waste being sent to the hot drains. Furthermore, chemistry data could allow the evaporator to operate at a higher volume reduction factor, and the system performance, such as decontamination factors, could be more accurately measured.

- Volumes in the OR-ILW monthly reports for CY 1979 account for only 59 percent of the total waste treated. Recognizing that some dilution of the system occurs from inleakage of surface water, pressurizing of lines with clean water, recycling of drain from dry wells, etc., any other major contributors should be listed for more complete accountability.

- The OR-ILW processes waste through a natural circulation evaporator (pot-type). This evaporator works well for low concentrations (less than 10 percent solids by weight) of soluble solutions. The types of solvents used for future process decontamination and decommissioning may be limited due to the type of waste evaporator in use. ORNL should review the effect of facility decontamination solutions on the evaporator process capability.

- The overview of the OR-ILW monitoring/control system revealed no significant findings or recommendations that would benefit ORNL. A more detailed review may uncover marginal improvements to the system.

4.3 HIGH LEVEL WASTE(5)

High level liquid waste results from the operation of the first cycle extraction system or from subsequent extraction cycles. HLW may also be waste from a process not using solvent extraction in a facility processing irradiated reactor fuel(8). The HLW system was not reviewed in detail as part of this study, since ORNL does not produce any significant quantity of HLW. HLW collection facilities have been installed in anticipation of future work that may produce such waste. Waste containing high concentrations of radioactivity (in Curies) could be stored in the HLW tanks to accommodate the higher heat generated.

4.3.1 Sources

Small quantities of highly radioactive wastes are generated by operations at ORNL. The following facilities are the main contributors:

- Pilot Plant - Building 3019
- Fission Product Development Laboratory - Building 3517
- Transuranium Facility (TRU)

4.3.2 Current Collection/Retention Practices

In 1964, two stainless steel, 50,000 gal tanks, C-1 and C-2, were installed to collect hot, acidic HLW. They are internally and externally cooled, designed to the requirements of ASME Code Section VIII, and capable of storing HLW with activities as high as 2,800 Ci/gal. Only C-2 would receive HLW; C-1 is available as a standby. To date, about 2,000 gal of Transuranium Facility highly radioactive waste has been delivered to Tank C-2.

4.3.3 Current Treatment Practices

HLW would be diluted with OR-ILW and either treated in the OR-ILW evaporator or sent directly to the hydrofracture facility.

4.3.4 Current Disposal Practices

The practice would be to dilute the HLW with OR-ILW and forward the mixture to the hydrofracture facility.

4.3.5 Current Monitoring/Control Practices

Monitoring and control practices for HLW were not assessed. Instrumentation on each collection tank continuously monitors the level, temperature, and specific gravity of the tank contents.

4.3.6 Recommendations/Conclusions

- A detailed review of the HLW collection, treatment, retention, and monitoring/control practices should be conducted. The following should be assessed: 1) source quantity (present and projected), 2) activity, 3) chemistry, 4) administrative limitations and procedures, 5) system, and 6) system design qualifications compliance with current standards.

- The environmental impact of mixing HLW with OR-ILW for hydrofracture disposal should be assessed. The assessment should consider encapsulation in a solidified monolith with retrievability.

4.4 TRANSURANIUM-CONTAMINATED WASTE(3,4)

4.4.1 Sources

The transuranic process area is the source of most of the transuranium-contaminated waste. Transuranium waste collected and processed has varied from 10,000 to 56,000 gal/yr. The waste source is administratively segregated in the transuranium process area prior to drainage in the T1/T2 tank farm or W5 tank area (part of the OR-ILW system).

4.4.2 Current Collection/Retention Practices

Transuranium waste is collected in ILW Tanks T1 and T2 which are located in the Melton Valley area or in W5 tank area. Both T1 and T2 have capacities of 15,000 gal each and service the 7900 area buildings. A new stainless steel, doubly-contained tank is being installed to receive these transuranium-contaminated wastes from Building 7920, the Transuranium Processing Facility. Transuranium waste will be pumped to OR-ILW evaporator service Tanks W21 and W22 when placed in service, unless the total activity is greater than 20 Ci/gal. If the Curie content should exceed this limit, the waste would be handled in accordance with a special DOE-approved plan. No special plan has been developed because the activity of the wastes has never remotely approached the above limit.

4.4.3 Current Treatment Practices

The transuranium waste is mixed with other waste collected in Melton Valley and OR-ILW waste collected in the Bethel Valley tank farms. The mixed waste is processed in the OR-ILW evaporator.

4.4.4 Current Disposal Practices

Current disposal is to inject the mixed OR-ILW-transuranium waste into the hydrofracture after the waste is diluted to meet current administrative activity limits.

4.4.5 Current Monitoring/Control Practices

Monitoring and control practices for the transuranium waste were not assessed.

4.4.6 Recommendations/Conclusions

- Administrative procedures should be established for the collection and processing of transuranium mixed wastes. The procedure could include the following: 1) segregation procedures for transuranium waste at the

Transuranic Process Facility, 2) reporting of routine monitoring and sampling for chemistry, activity, and volume source in Tanks T1, T2, and W5, 3) waste process dilution procedures for mixing OR-ILW and transuranium waste prior to treatment, and 4) special procedures or provisional plans for the ultimate disposal if waste activity is greater than 10 nCi/gm of transuranics.

- Provisional encapsulation techniques and retrievable storage should be assessed for transuranium waste if the activity level exceeds administrative limits for retrievability of 10 nCi/gm of transuranics.

4.5 REFERENCES

1. Oak Ridge National Laboratory, Radioactive Waste Disposal Operations and Effluent Monitoring (Monthly Reports), January 1970 through June 1979.

2. Oak Ridge National Laboratory, Safety Analysis Report - Building 3544 Process Waste Treatment Plant, ORNL/TM-5444, June 1976.

3. Gilbert/Commonwealth, "Site Survey Oak Ridge National Laboratory Radioactive Waste Management Systems," prepared for Oak Ridge National Laboratory, September 1979.

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5. Binford, F. T. and S. D. Orfi, "The Intermediate-Level Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis," Draft Report, November 21, 1978.

6. Energy Research and Development Administration, Management of Intermediate Level Radioactive Waste Oak Ridge National Laboratory, Final Environmental Impact Statement, ERDA-1553, September 1977.

7. Personal Communication (note), from L. Lasher (ORNL Waste Management Operations Staff) to G. Costomiris (Gilbert/Commonwealth), September 12, 1979.

8. DOE Manual, Chapter 0511.

SECTION 5.0
SOLID WASTE

5.1 SOURCES(1)

Solid waste at ORNL comes from virtually every operating facility. More than 80 percent of the waste volume currently produced is a low level, heterogeneous mass of absorbent paper, glassware, scrap metal, dirt, various filter media and frames, lumber, oils, powder, wire, depleted uranium, animal carcasses used for biological experiments, and experimental equipment that could not be economically decontaminated.

At the source facility, a burial authorization form is completed for each waste container. This form documents the source, radioactive isotopes in the waste, radiation level, and any notable precautions or hazards concerning the waste.

The waste is picked up at approximately 20 points. Shipments are also received from other facilities as agreed to between ORNL and DOE. The volume of waste received from other facilities has been very low since 1965 when ORNL ceased to be the Southern Regional Burial Ground. Table 5.1-1 lists annual activity, volume, and weight of solid waste buried or stored at ORNL for fiscal years 1943 through the first nine months of 1979(2). Prior to 1971, records of the Curie content of solid waste are not accurate and have been limited to special burials and materials requiring accountability. However, the radioactivity due to solid waste is relatively small compared to the more than 1 million Curies of liquid waste in open pits and trenches prior to 1966 when surface disposal of liquid waste was discontinued.

5.2 CURRENT COLLECTION/RETENTION PRACTICES(1)

Low level, compactible waste (<200 mr/hr) is collected in plastic bags and placed in yellow walk-in dumpsters (Figure 5.2-1). When full, the dumpsters are transported to the compactor facility. Low level, noncompactible waste is

TABLE 5.1-1
TOTAL ANNUAL ACTIVITY, VOLUME, AND WEIGHT
OF SOLID WASTE BURIED OR STORED

Fiscal Year	Activity, Ci	Volume, ft^3	Weight, lb
43	2.0×10^3	2.5×10^4	3.0×10^5
44	2.0×10^3	2.5×10^4	3.0×10^5
45	2.0×10^3	2.5×10^4	3.0×10^5
46	2.0×10^3	2.5×10^4	3.0×10^5
47	1.0×10^4	1.4×10^5	2.0×10^6
48	1.0×10^4	1.4×10^5	2.0×10^6
49	1.0×10^4	1.4×10^5	2.0×10^6
50	1.0×10^4	1.4×10^5	2.0×10^6
51	1.0×10^4	1.4×10^5	2.0×10^6
52	1.0×10^4	2.0×10^5	2.0×10^6
53	1.0×10^4	2.0×10^5	2.0×10^6
54	1.0×10^4	2.0×10^5	2.0×10^6
55	1.0×10^4	2.0×10^5	2.0×10^6
56	1.0×10^4	2.0×10^5	2.0×10^6
57	2.0×10^4	3.2×10^5	4.0×10^6
58	2.0×10^4	3.2×10^5	4.0×10^6
59	2.0×10^4	3.2×10^5	4.0×10^6
60	2.0×10^4	3.2×10^5	4.0×10^6
61	4.0×10^4	5.31×10^5	6.0×10^6
62	3.0×10^4	4.24×10^5	5.0×10^6
63	2.0×10^4	3.33×10^5	4.0×10^6
64	2.0×10^4	3.21×10^5	4.0×10^6
65	1.0×10^4	1.89×10^5	2.0×10^6
66	1.0×10^4	1.59×10^5	2.0×10^6
67	1.0×10^4	1.99×10^5	2.0×10^6
68	2.0×10^4	2.42×10^5	3.0×10^6
69	1.0×10^4	1.92×10^5	2.0×10^6
70	1.0×10^4	1.28×10^5	1.0×10^6
71	1.1×10^4	1.67×10^5	2.29×10^6
72	1.0×10^4	1.29×10^5	1.90×10^6
73	9.0×10^3	1.07×10^5	1.57×10^6
74	8.8×10^3	1.20×10^5	1.55×10^6
75	2.0×10^3	1.12×10^5	1.41×10^6
76(A)	1.1×10^4	1.25×10^5	1.49×10^6
77(B)	3.07×10^3	7.86×10^4	3.71×10^5
78	5.25×10^3	8.32×10^4	9.24×10^5
79 (9 mos.)	5.53×10^4 (C)	5.13×10^4	9.82×10^5

(A) July 1, 1975 through September 30, 1976 - Reflects change in fiscal year to begin in October.

(B) Activity and weight shown is for second half of FY77 only. Values for the first half are not available.

(C) Nuclide 3 (fission product) has a listing of 5×10^4 Curies of Sr-90. Without this the total Curies would be 5.29×10^3.

FIGURE 5.2-1
COMPACTIBLE WASTE IN A DUMPSTER

collected in yellow dempsey dumpsters (top loading), and high level waste ($\geq$200 mr/hr) is collected in lead shielded, dempsey dumpsters. Figure 5.2-2 shows a dempsey dumpster on the left and a walk-in dumpster on the right. When full, the dempsey dumpsters are transported to Burial Ground 6 and the contents placed in burial trenches.

Waste suspected of being contaminated but having no measurable radiation is collected in green dumpsters and used as landfill. All other radioactive wastes are packaged in suitable containers and transported, with shielding if necessary, to either the TRU area of Burial Ground 5, if retreivability is required, or Burial Ground 6.

5.3 CURRENT TREATMENT PRACTICES(1)

The only current treatment of solid waste is compaction of low level waste. Approximately 30,000 f^3/yr are compacted out of a total solid waste volume of approximately 80,000 ft^3. Low level compactible waste has a surface radiation level of less than 200 mr/hr when packaged in plastic bags. Approximately 90 percent of the low level waste has a radiation level of less than 10 mr/hr, with the remaining 10 percent ranging between 10 and 200 mr/hr prior to compaction.

The compactible waste is fed into a Consolidated Baling Company compactor, Model Number DHBS-2MR (Figure 5.3-1). The machine produces bales of waste in rectangular cardboard boxes approximately 20x30x40 inches (15 ft^3) weighing 670 lb which are bound with four metal straps. The machine will compact small hardware items such as tubing, small bottles, and cans, in addition to normal compactible waste, such as paper and clothing. Current operations are achieving a compaction ratio of approximately 9-to-1. The machine nas been in use for about one year, during which approximately 100 bales have been produced.

An alternative approach for processing ORNL solid wastes is under study. The concept is to produce waste pellets of 1/8 inch diameter x 1/2 inch long (maximum) that would be injected in the hydrofracture in a slurry with OR-ILW. A preconceptual design for this concept is illustrated in Figure 5.3-2(3). A

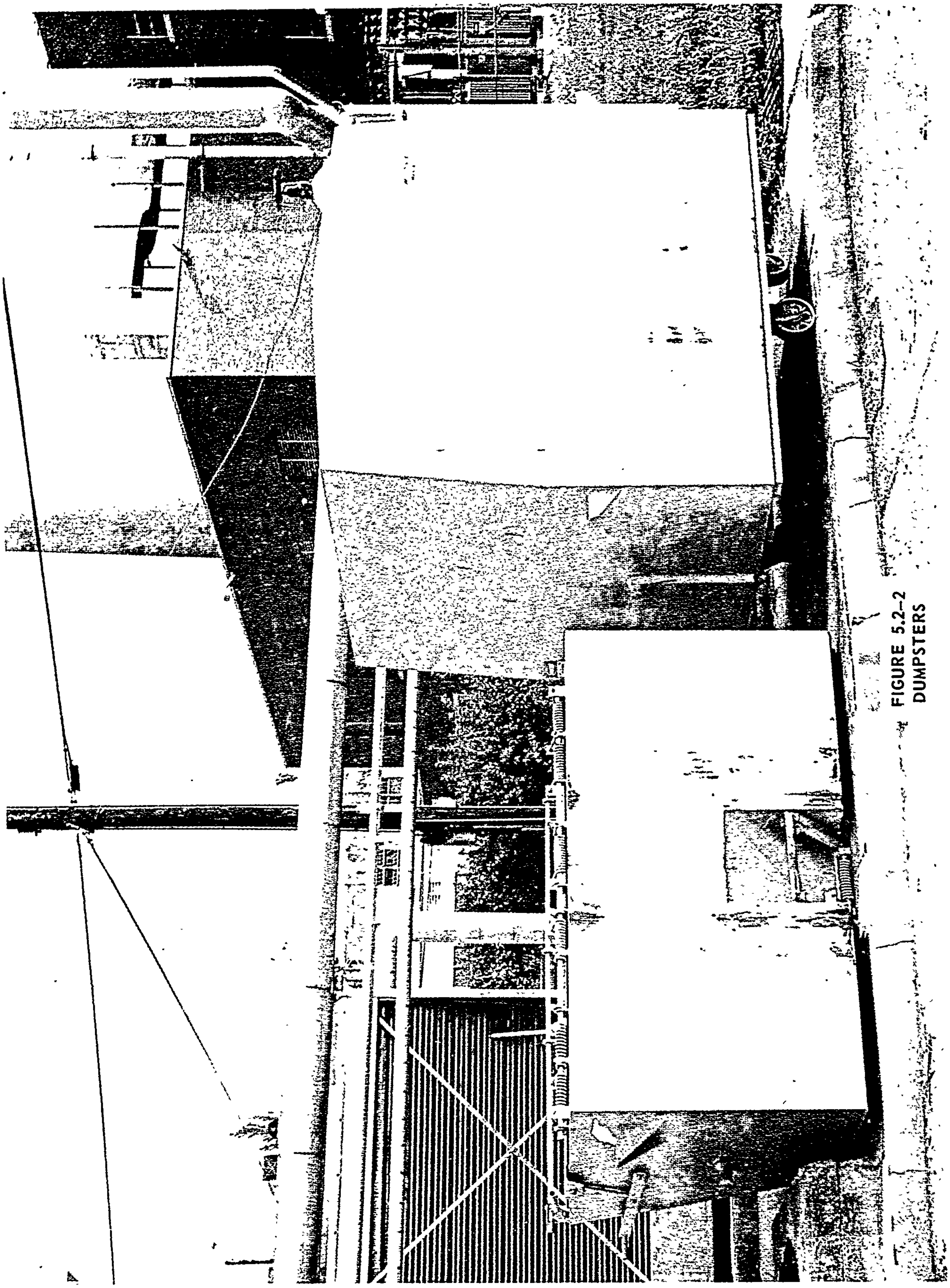


FIGURE 5.2-2
DUMPSTERS

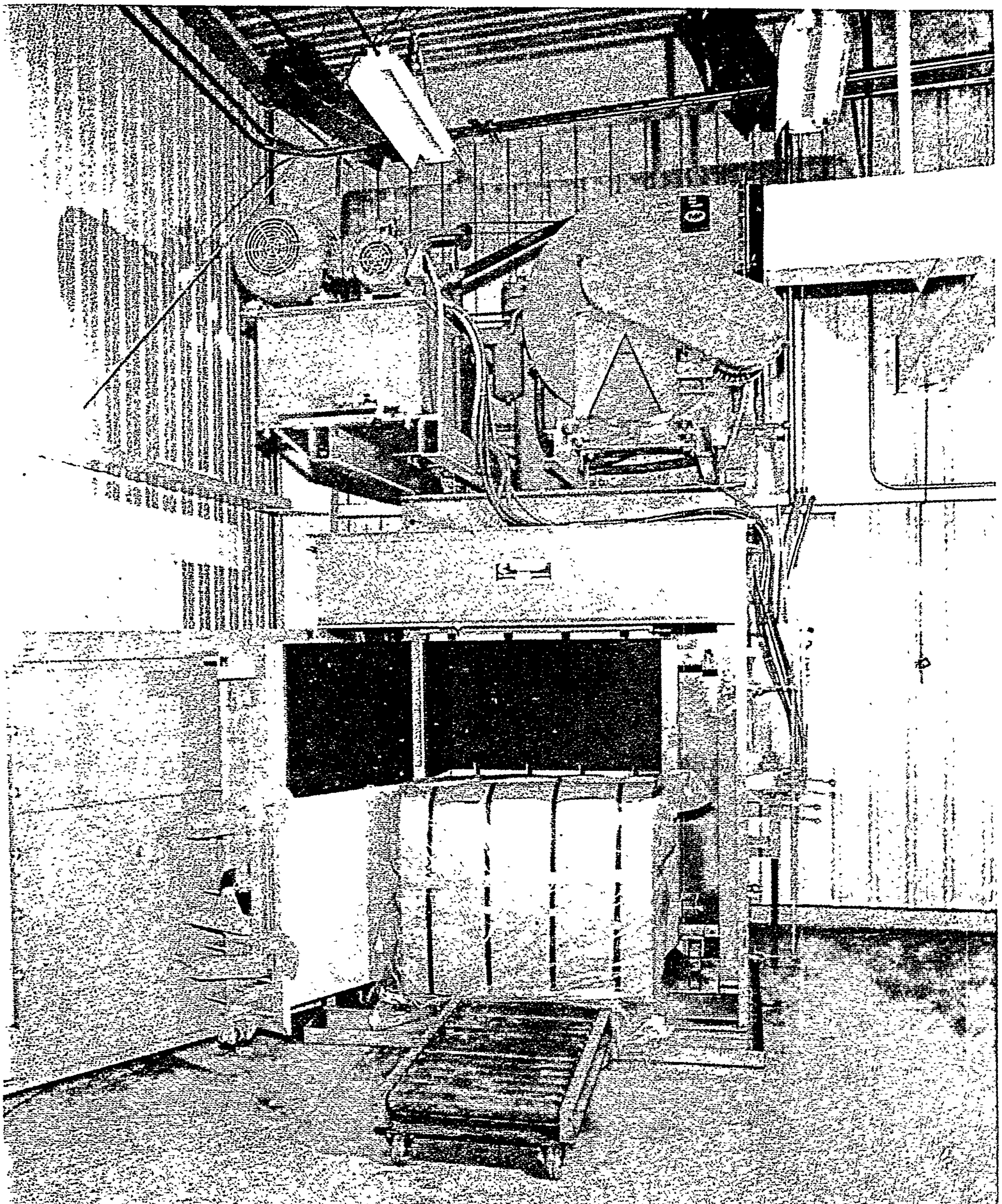


FIGURE 5.3-1
COMPACTOR

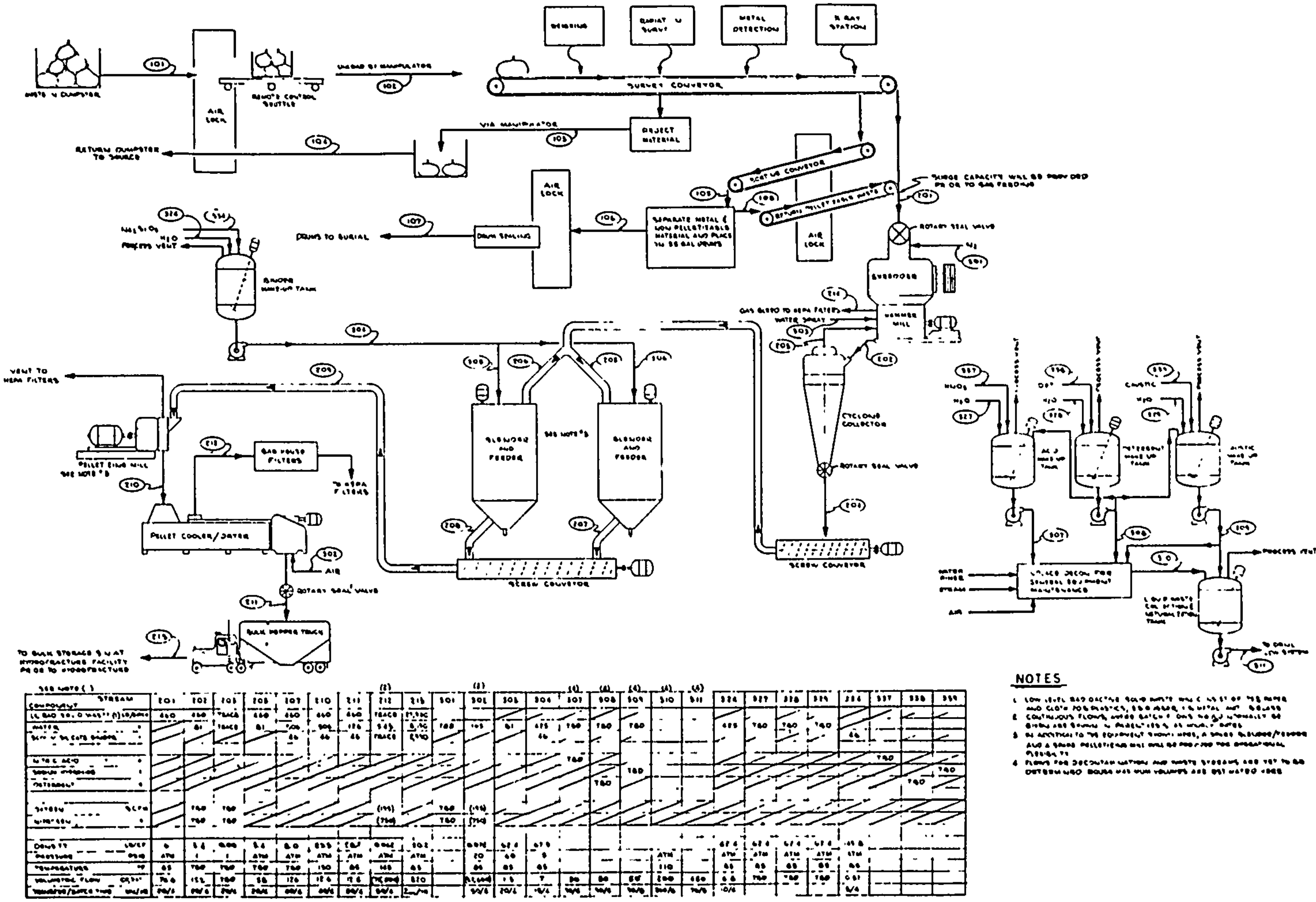


FIGURE 5.3-2
SOLID WASTE PROCESSING FACILITY (30,000 FT^3/YR)
PROCESS FLOW DIAGRAM

study is underway to examine the design requirements for facilities capable of processing 30,000, 100,000, and 200,000 ft^3/yr of waste in this manner. This includes equipment for receiving, monitoring, sorting, shredding or pulverizing, blending with a binder, and pelletizing. The effort includes producing pellets using sodium silicate (Na_2SiO_3) and other binders to achieve specified pellet properties, such as shape, specific gravity, permeability, physical integrity, and pumpability into the hydrofracture.

5.4 CURRENT DISPOSAL/STORAGE PRACTICES(1)

The low level, heterogeneous solid waste described in Section 5.1 is buried in trenches or used as landfill. Material that cannot be safely disposed of in open trenches and materials that require special identification and separation from other wastes, such as transuranium wastes (>10 nCi/gm), hot-cell scrap containing fissionable materials, and mixed radionuclides with high specific activities, are buried or stored via special techniques.

A solid waste information management system, (SWIMS) begun in FY 77, classifies solid waste into eight nuclide categories as follows(4):

1 TRU	4 - Induced Activity	7 - Alpha
2 - Uranium/thorium	5 - Tritium	8 - Other
3 - Fission product	6 - Beta-Gamma-TRU	

Each category has a listing of waste generated by ORNL and waste received from outside sources for burial or storage.

Solid waste was classified from 1970 until FY 77 as either general radwaste, fissile or TRU. From 1943 to 1970, all solid waste was classified in one category.

For disposal, solid waste is classified as: TRU waste, fissile waste, or other wastes. TRU waste is buried or stored, in a retrievable manner, in a fenced-off area of Burial Ground 5. All other waste is buried in Burial Ground 6. The location of these burial grounds in relation to the ORNL site is shown in Figure 4.1-1. A flow diagram of the solid waste disposal operations is given in Fig. 5.4-1. Spent fuel is shipped to the Savannah River Laboratory.

Six burial sites have been used since operation began in 1943. Operational data on these sites is shown in Table 5.4-1. The first three were located without geologic and hydrologic explorations, because little emphasis was placed on site evaluation due to the relatively small amount of waste handled at that time. However, as the volume and variety of wastes increased, greater consideration was given to geologic and hydrogeologic factors in the selection of sites for burial grounds.

TABLE 5.4-1

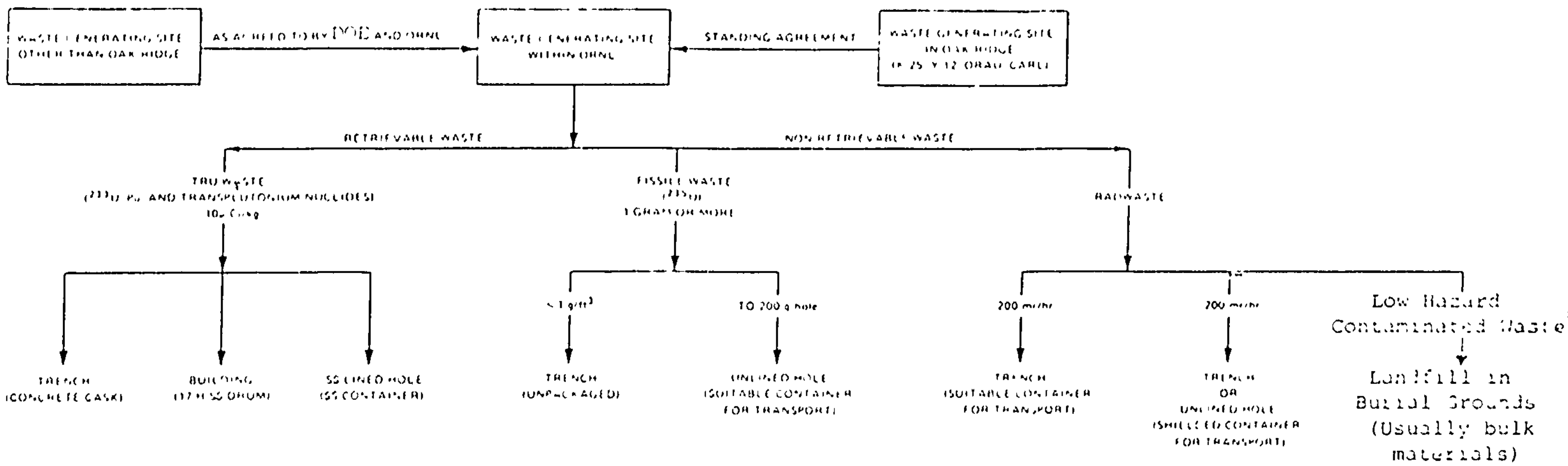
OPERATIONAL STATUS OF ORNL SOLID WASTE DISPOSAL AREAS(5)

Sites	Operating Dates	Status	Acreage	Notes
1 and 2	1943 - 1946	Closed	5	No geologic or hydrologic exploration
3	1946 - 1951	Closed	7	
4	1951 - 1959	Closed	23	Shale
5	1959 -	Closed except for TRU waste	33	3.5 acres available for retrievable storage
6	1969 -	Operating	68	

5.4.1 TRU Waste

TRU waste is classified in three ways as: TRU; low level, beta-gamma TRU; or high level, beta-gamma TRU. All three represent approximately 7 volume percent of all solid waste. TRU waste is buried or stored, in a retrievable manner, in a fenced-off area of Burial Ground 5 (Figure 5.4-2) as described below.

TRU waste is packaged in 55 gal stainless steel drums. The drums are stored in a concrete building with a removable, sectional, metal roof which is approximately 1 ft above grade. The building has 24 square cells in which



* Waste with no measurable contamination by radiation survey but judged by the generator, because of its history, to be radioactively contaminated above "green tag" limits.

FIGURE 5.4-1
ORNL SOLID WASTE DISPOSAL OPERATIONS

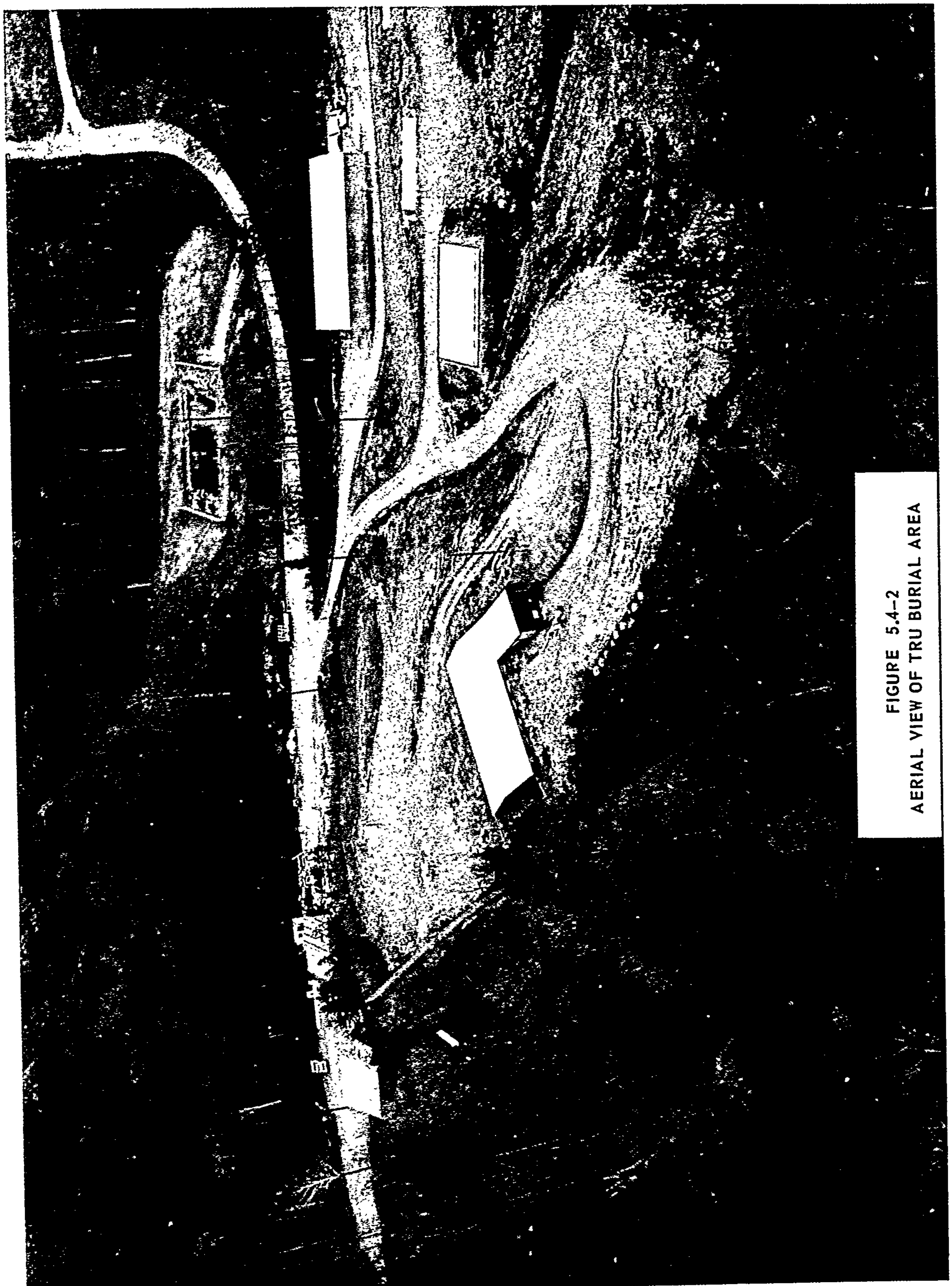


FIGURE 5.4-2
AERIAL VIEW OF TRU BURIAL AREA

drums are stacked 16 to a layer, 4 layers high, for a total capacity of 1,536 drums. The radiation level of the drums is such that no special precautions are required with regard to personnel exposure. Dimensions of the building are given in Figures 5.4-3 and 5.4-4. The building is shown on the right in Figure 5.4-5. Construction of a second building is nearing completion. It is identical to the first building except that the cells are designed to store 5 layers, and each cell has a removable concrete plug instead of a metal roof.

Containers of low level, beta-gamma TRU waste are placed in concrete casks which are then buried in trenches. A typical trench with casks is shown in Figure 5.4-6. The casks have wall thicknesses of 4.5, 6, or 12 inches to reduce the surface radiation of the cask to less than 200 mr/hr. A lifting cable, used in transporting the cask, is buried with the cask to aid in near term retreivability. A typical trench is visible (near the mound of dirt) in the background of Figure 5.4-5. Construction of a partially underground concrete structure, termed a cave, is nearing completion. Concrete casks are scheduled to be stored in the cave starting in January 1980. The facility has an estimated storage capacity of five years at the present rate of generation.

Containers of high level, beta-gamma TRU waste are stored in stainless steel lined holes, termed thimbles, which have bottom plates welded to them. The containers are of various sizes (10, 12, 16, or 30 gal) and are transported to the site in a shielded cask. In storing a container, the cask is placed over the hole, the container is lifted slightly by an attached cable projecting through the top of the cask, the cask bottom is slid open, and the container and cable are lowered into the hole. A concrete plug is placed over the hole after the cask is removed. The thimbles, with plugs projecting above grade, are shown at the left of Figure 5.4-5.

5.4.2 Fissile Waste

Fissile waste having less than 1 g/ft^3 of fissile material is buried, unpackaged, in a trench. Fissile waste having at least 1 g/ft^3 of fissile material is buried in a suitable container in an unlined, 42 inch diameter by 20 ft deep augered hole. A typical procedure for burying a container is as

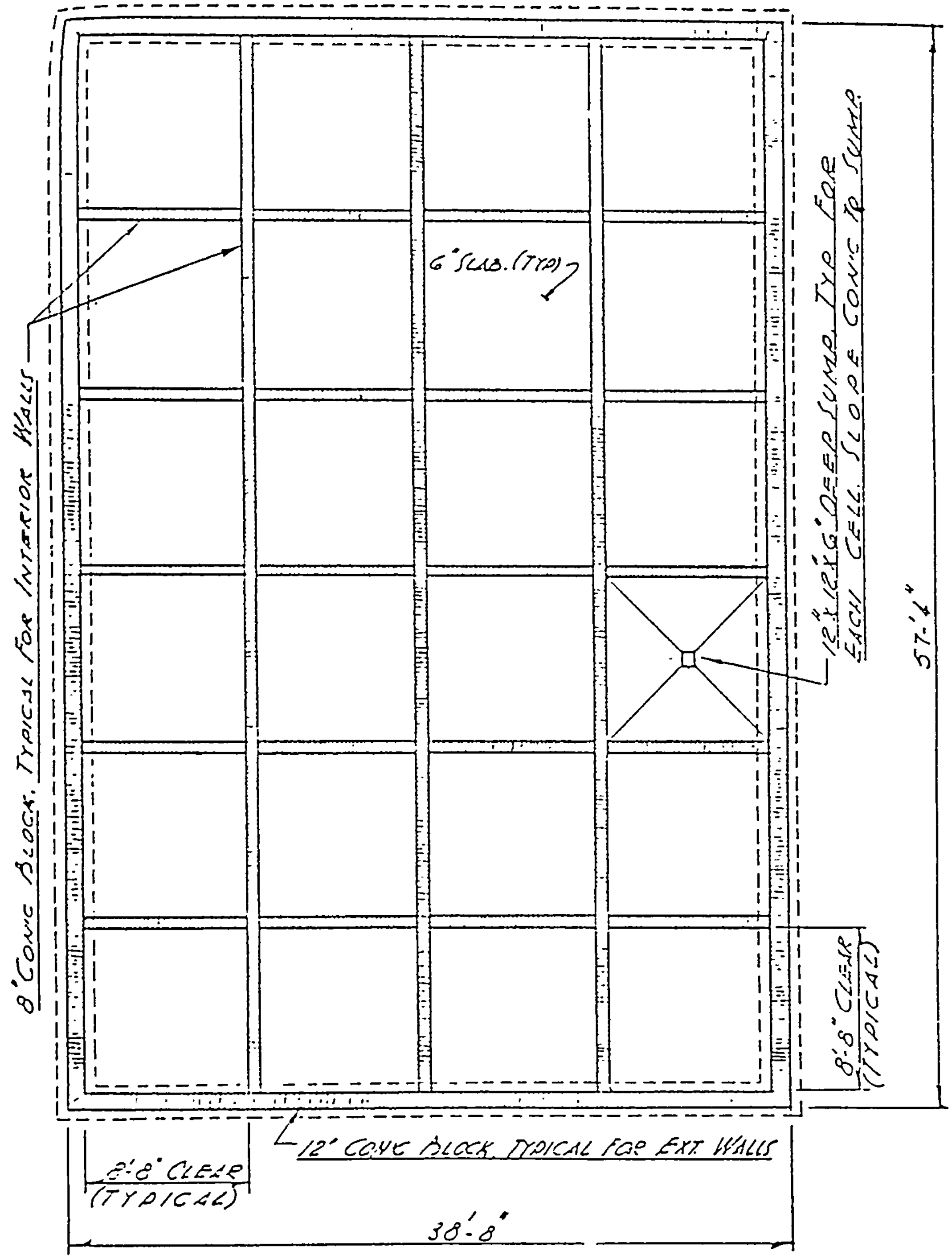


FIGURE 5.4-3
FLOOR PLAN
STORAGE FACILITY FOR RETRIEVABLE WASTE
PACKAGED IN 55 GALLON DRUMS

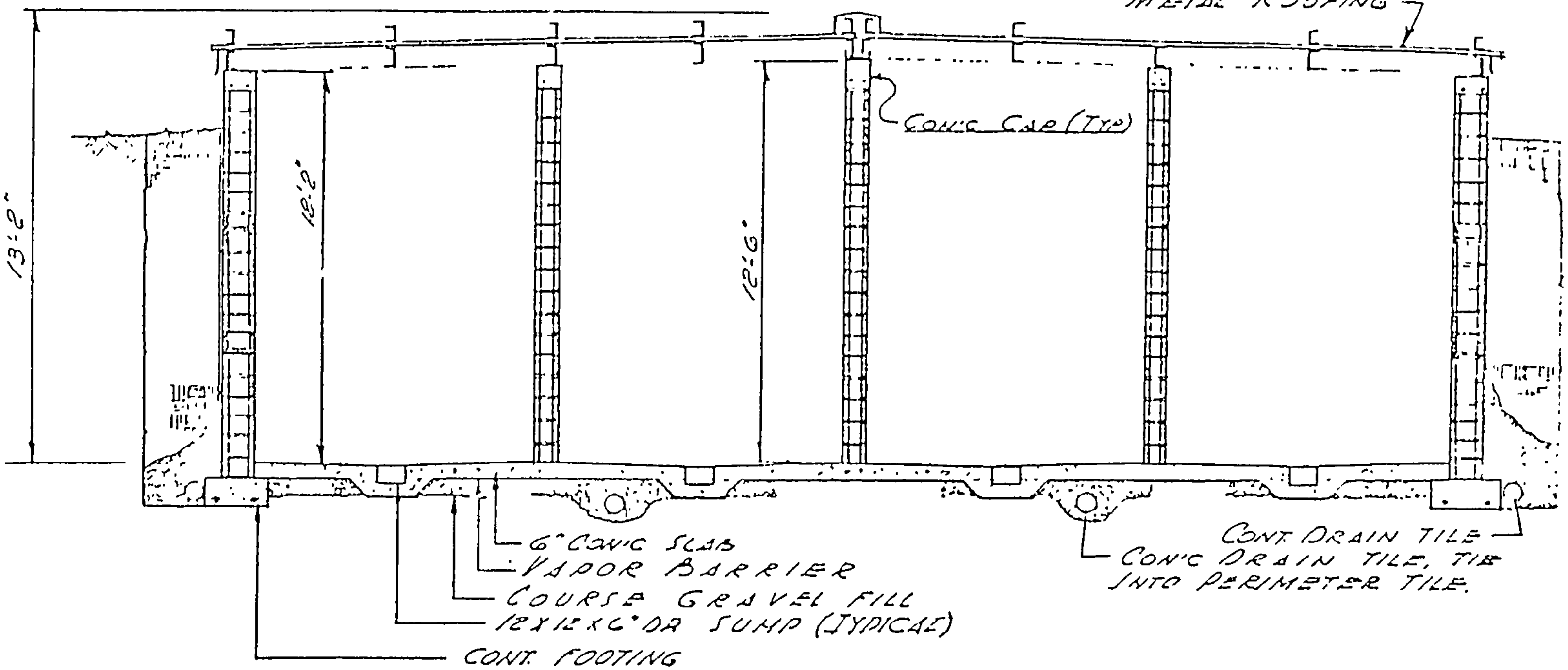


FIGURE 5.4-4
CROSS SECTION
STORAGE FACILITY FOR RETRIEVABLE WASTE
PACKAGED IN 55 GALLON DRUMS

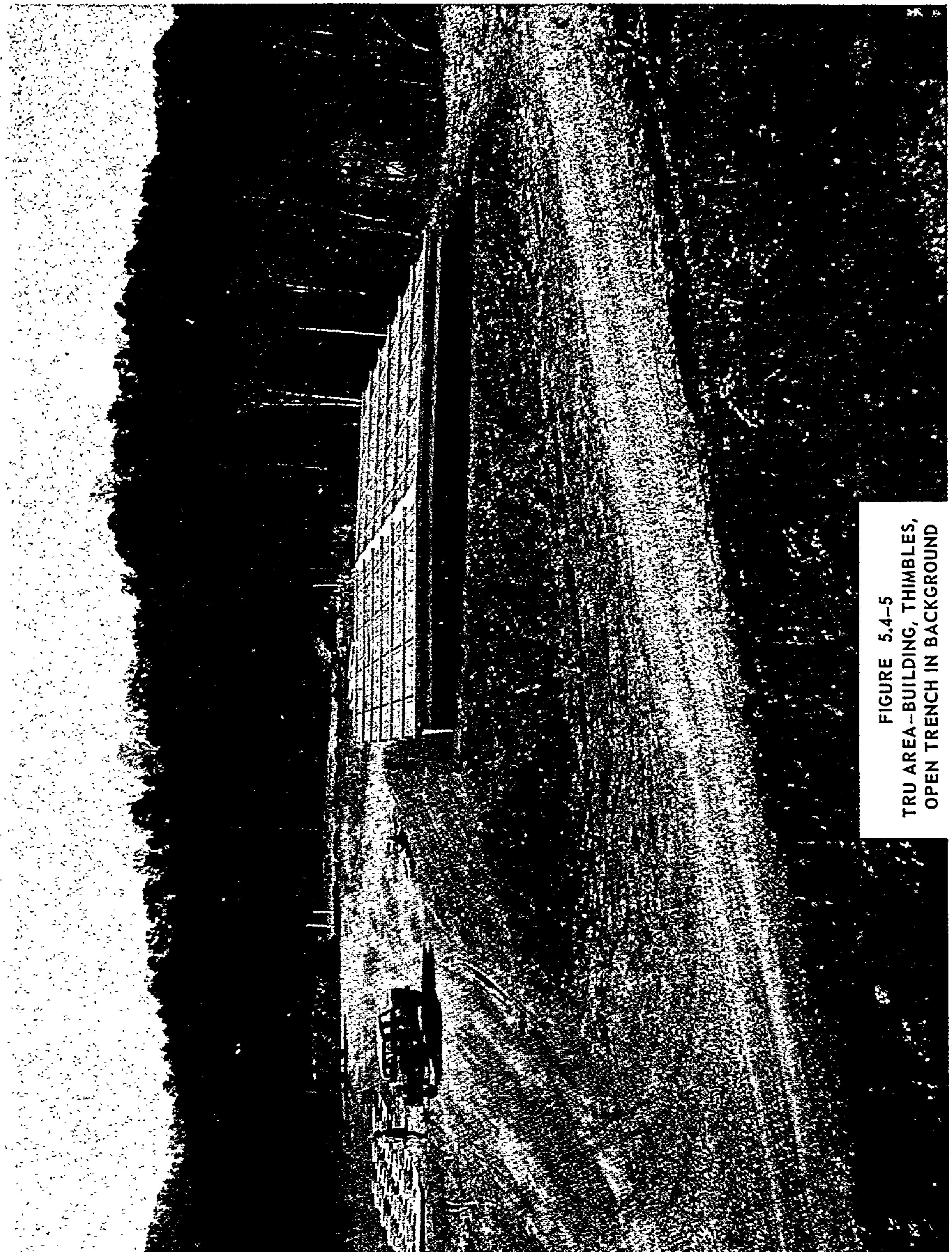


FIGURE 5.4-5
TRU AREA-BUILDING, THIMBLES,
OPEN TRENCH IN BACKGROUND

FIGURE 5.4-6
BETA-GAMMA TRU WASTE IN CONCRETE CASKS IN TRENCH

follows: A crane transfers a cask containing a burial container from a truck to a metal plate over the top of the hole. The container is lowered from the cask through a hole in the plate into the burial hole, and the cask is removed. The container is covered with soil until the surface reading is 200 mr/hr or less. The metal plate is removed, and the hole is covered with a metal cap until another container is received for burial. At a minimum of 2 ft below the surface, 4 lb/ft^2 of bentonite are disked into the soil. The hole is topped up with soil.

5.4.3 Other Wastes

All other solid waste is buried in trenches or used as landfill. Bales of compacted waste are stacked in relatively shallow (less than 5 ft) trenches. The depth of the trench is limited by OSHA requirements, since an operator sometimes enters the trench to assist in stacking the bales. Other wastes of detectable radiation are randomly dumped in deeper trenches. Waste which has no measurable radiation, but is judged by the generator to be contaminated, is used as landfill as shown in Figure 5.4-7.

5.5 CURRENT MONITORING/CONTROL PRACTICES(1)

Trenches have vertical corrugated pipe extending from the bottom of the trench to about 3 ft above the surface. These are used to monitor seepage from the trench. A monitor pipe is visible at the right of Figure 5.4-6.

An area monitor for personnel protection is located in the compactor building.

Various sampling stations along White Oak Creek and Melton Branch measure the quantity of activity entering these waterways via seepage or rainwater runoff for burial grounds.

5.6 RECOMMENDATIONS/CONCLUSIONS

- Suitable burial sites at ORNL are limited. Accordingly, the potential for and cost/benefit of applying other volume reduction techniques such as slagging pyrolysis should be reviewed as additions or alternatives to the current compactor to obtain greater volume reduction.

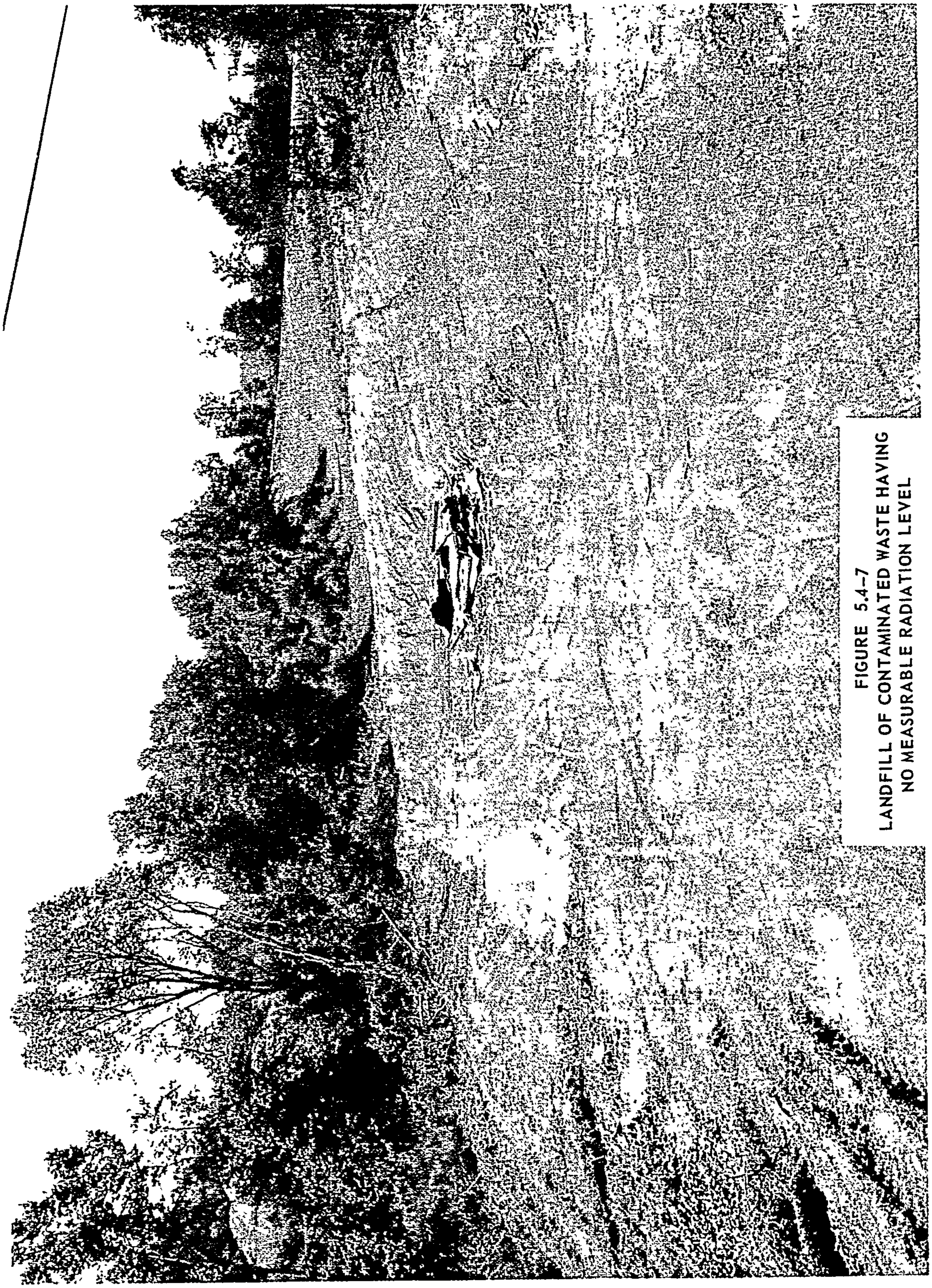


FIGURE 5.4-7
LANDFILL OF CONTAMINATED WASTE HAVING
NO MEASURABLE RADIATION LEVEL

- Electropolishing should be considered for decontamination of equipment. It is being applied successfully to the decontamination of radioactive metal parts at the "N" nuclear reactor at Hanford. Radiation levels can be reduced to essentially background which would permit equipment and tools to be reclaimed and reduce the inventory of solid waste to be buried.

- Compaction of TRU waste being stored in the 55 gal drums would reduce the number of drums to be stored.

- Storage of compacted waste in square containers would permit storage of 27 percent more waste volume in the space required for circular containers. Stainless steel square containers can be purchased for \$14 to \$15/ft^3 of capacity. The stainless 55 gal drums are priced at \$160 to \$170 (\$22/ft^3 of capacity).

- Alternate methods of solid waste disposal should be considered because of the possibility that the existing sites do not have acceptable hydrogeologic conditions. Continued use of shallow land burial may cause the existing seepage and migration problems to become more acute. The desirability of providing interim retrievable storage should be considered while disposal alternatives are being evaluated.

5.7 REFERENCES

1. Gilbert/Commonwealth, "Site Survey Oak Ridge National Laboratory Radioactive Waste Management Systems," prepared for Oak Ridge National Laboratory, September 1979.

2. Personal communication (note with attachments), from J. Coobs (ORNL Waste Management Operations Staff) to G. Costomiris (Gilbert/Commonwealth), September 5, 1979.

3. Oak Ridge National Laboratory, "Solid Waste Processing Facility Process Flow Diagram (Drawing No. J3E21276/E100), May 1979.

4. Energy Research and Development Administration, "Solid Radioactive Waste Data Form-Operational Data," Form ERDA-735, May 1976.

5. Oak Ridge National Laboratory, Waste Management at ORNL: Present Practices - Immediate Needs - The Future, ORNL Central Files Number 72-9-1, September 1972.

Chemical Form of nuclide rel'd from RTP emission point

HAP end of mey

ECTION 6.0

ASEOUS WASTE

...led at ORNL fall into two classifications: ...s. Cell ventilation air originates in areas ...ells and accounts for more than 99 percent of the volu... ...ctivity. The off-gas, consisting of exhaust gas from chemical proce... ...s and other operating equipment, accounts for very little volume, but contains most of the activity.

6.2 CURRENT COLLECTION/RETENTION PRACTICES

Currently, gaseous waste is collected in duct work at those facilities which generate radioactive gaseous effluent. The gas is then discharged from one of the following stacks: 3039, 7911, 3020, 2026, 6010, or 7603. All gaseous effluent is moved through the system via the use of fans/blowers. At present, all fans have a backup for moving the effluent. However, the backup fans do not provide 100 percent of system capacity. At present, no means exists for retaining and cleaning up gaseous effluents within the collection system or in a separate holdup system.

Some laboratories which generate small quantities of radioactive gases are permitted to discharge the effluent directly to the atmosphere through their respective building ventilation systems. The gaseous effluents from these areas are sampled continuously, and the analytical results are reported on a monthly basis.

6.2.1 Stack 3039

Gaseous wastes are routed to stack 3039 from the following areas at the flow rates indicated.

Area	Flow Rate (CFM)(1,2)
Bldg. 3500 I&C, chem, res.	16,500 (existing)/31,000 (proposed)
Bldg. 4500 Res & Admin	42,000 (existing)/55,000 (proposed)
Bldgs. 3025/3026 Rad Lab	60,000
Bldg. 3110 3SC. area vent filter	42,500 (existing)/54,000 (proposed)
Bldg. 3042 ORR	9,000
Bldg. 3092	4,000
Bldg. 3042 - off gas ORR	2,000

This stack is 250 ft high, and the inside diameter is 22 ft at the base and 8 ft at the top(3). Figure 6.2-1 shows the collection system for Stack 3039.

6.2.2 Stack 7911

Gaseous wastes are routed to Stack 7911 from the following areas:

- o HFIR (Bldg. 7900 - High Flux Isotope Reactor)
- o TRU (Bldg. 7920 - Transuranium Processing Plant)
- o TURF (Bldg. 7930 - Thorium - Uranium Recycle Facility)

The average stack discharge rate is 50,000 cfm. This stack is 250 ft high, and the inside diameter is 14 ft at the base and 5 ft at the top(3).

6.2.3 Stack 3020

Building 3019 is the principal contributor of gaseous waste directed to the 3020 stack. The stack has a double wall, is 200 ft high, and has an inside wall diameter of 6.5 ft. The average discharge rate is approximately 25,000 cfm(3).

6.2.4 Stack 2026

This stack serves only the High Radiation Level Analytical Laboratory. This metal stack is 75 ft high with an inside diameter of 3.5 ft. The average stack discharge rate is approximately 22,000 cfm(3).

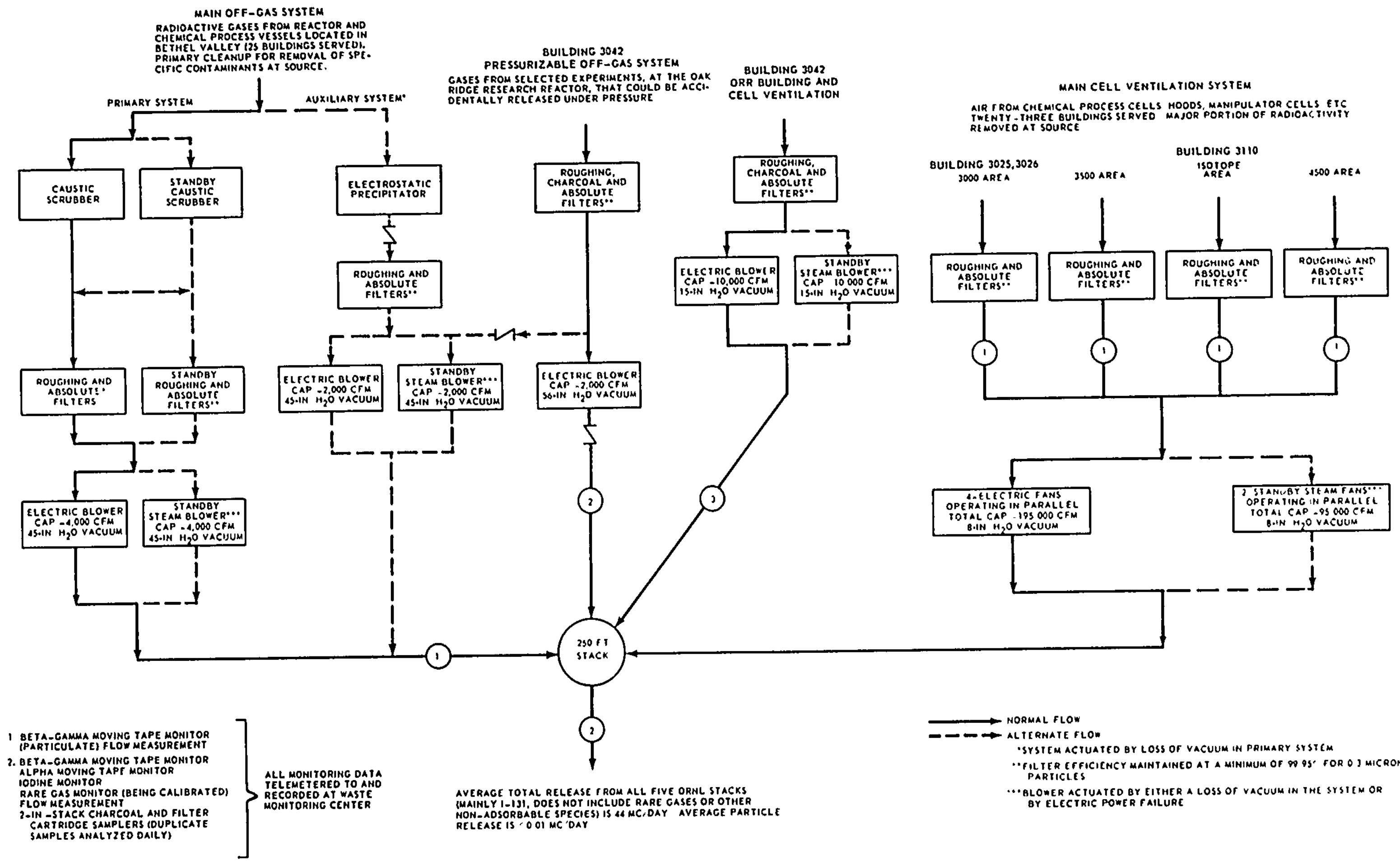


FIGURE 6.2-1
CENTRAL GASEOUS WASTE DISPOSAL SYSTEM, 3039 STACK AREA

6.2.5 Stack 6010

This stack serves the Oak Ridge Electron Linear Accelerator (ORELA). The stack is metal and 47 ft high with an inside diameter of 2.5 ft. The stack average discharge rate is approximately 16,000 cfm(3).

6.2.6 Stack 7503

Gaseous effluents from the Molten Salt Reactor Experiment (MSRE) are discharged from Stack 7503. It is a metal stack, 100 ft high, with an inside diameter of 4 ft at the base and 3 ft at the top. The average discharge rate is approximately 10,000 cfm(3). The MSRE is not operating at present.

6.3 CURRENT TREATMENT PRACTICES

Radioactive gases are treated by one or more of the following:

- Charcoal filtering
- Roughing filtering
- HEPA filtering
- Gas scrubbing (caustic)
- Electrostatic precipitation

It is the responsibility of the gaseous waste generator to perform first order cleanup. This is accomplished with either HEPA, roughing, and/or charcoal filters to remove particulates and iodines from the gas stream. The effluent may be ducted to one of the stacks or directly to the atmosphere through a roof exhaust. The gaseous effluents produced from the reactor and chemical process vessels located in Bethel Valley and released through Stack 3039 can be routed through caustic scrubbers prior to release. This process removes the soluble isotopes and those isotopes which combine with the scrubbing fluid. In the event of a loss of primary vacuum, the gas is routed through an electrostatic precipitator prior to release. All other radioactive gases released from stacks are filtered prior to release.

Table 6.3-1 shows the monthly average of radioactive gaseous releases from 1970 to 1979. This is graphically shown on Figure 6.3-1 for 1965 to 1979. The drop in activity release from 1978 to 1979 is credited to proper handling of I-131 gases at the source point and a probable reduction in the quantity of isotopes processed. The 1978 average would have been substantially lower had an I-131 spill not occured.

Table 6.3-2 presents the release of noble gases in terms of percentage of the concentration guide (CG) limit from 1970 to 1979. These values are based on direct radiation instrument measurements in the stack gas stream and an assumed mixture of noble gases.

6.4 CURRENT MONITORING/CONTROL PRACTICES

Continuous effluent monitoring and sample collection methods are used on principal ventilation ducts and release stacks. All instrumentation transmit signals to the Control Complex for monitoring and recording. Gaseous effluents are monitored for one or more of the following contaminants before being discharged to the atmosphere: beta-gamma emitting particulates, alpha emitting particulates, radioiodine, inert gases such as xenon, krypton, and argon, and other radioactive gases. Special in-stack samplers collect inventory samples. Data obtained from analysis of these samples together with sampling time and effluent flowrates are used to determine total particulate and radioactivity discharged.

Radiation and flow monitoring devices are similar for all the stacks and major ducts. The description of the 3039 stack monitoring and sampling system is typical of those used on other stacks. Stack monitors are located on a platform at the 3039 Stack 50 ft level (Figure 6.4-1) except for the inert gas monitor which is located at ground level. The gaseous effluent stream is monitored for beta-gamma emitting particulates, alpha emitting particulates, radioactive gases, and iodine. Table 6.4-1 lists the specific monitors, along with flowrate measurement capability. In-stack samplers collect samples for analysis (Figure 6.4-2).

TABLE 6.3-1

GASEOUS WASTE RELEASES[(A)]
(MONTHLY AVERAGE, CURIES)

Source	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979 (6 Mos.)
Stack 2026	< .01	< .01	0	< .01	0	< .01	< .01	< .01	< .01	< .01
Stack 3039	.25	.25	.08	.12	.15	.16	≤ .09	≤ .10	≤ .13	≤ .02
Stack 3020	< .01	< .01	0	0	0	< .01	< .01	< .01	< .01	< .01
Stack 7512	< .01	< .01	0	0	0	< .01	< .01	0	< .01	< .01
Stack 7911	.04	.04	.05	.06	.01	.01	≤ .02	≤ .02	≤ .02	≤ .01
Total of Above (X-10 Area)	.29	.29	.13	.18	.16	.17	≤ .10	≤ .11	≤ .14	≤ .03
Tritium Target Fab. Bldg. (As Tritium))	-	-	-	-	5.02	3.07	1.60	2.0	1.23	(B)

(A) Activity is primarily I-131, except as noted; does not include noble gases.

(B) New instrumentation being installed since August 1978.

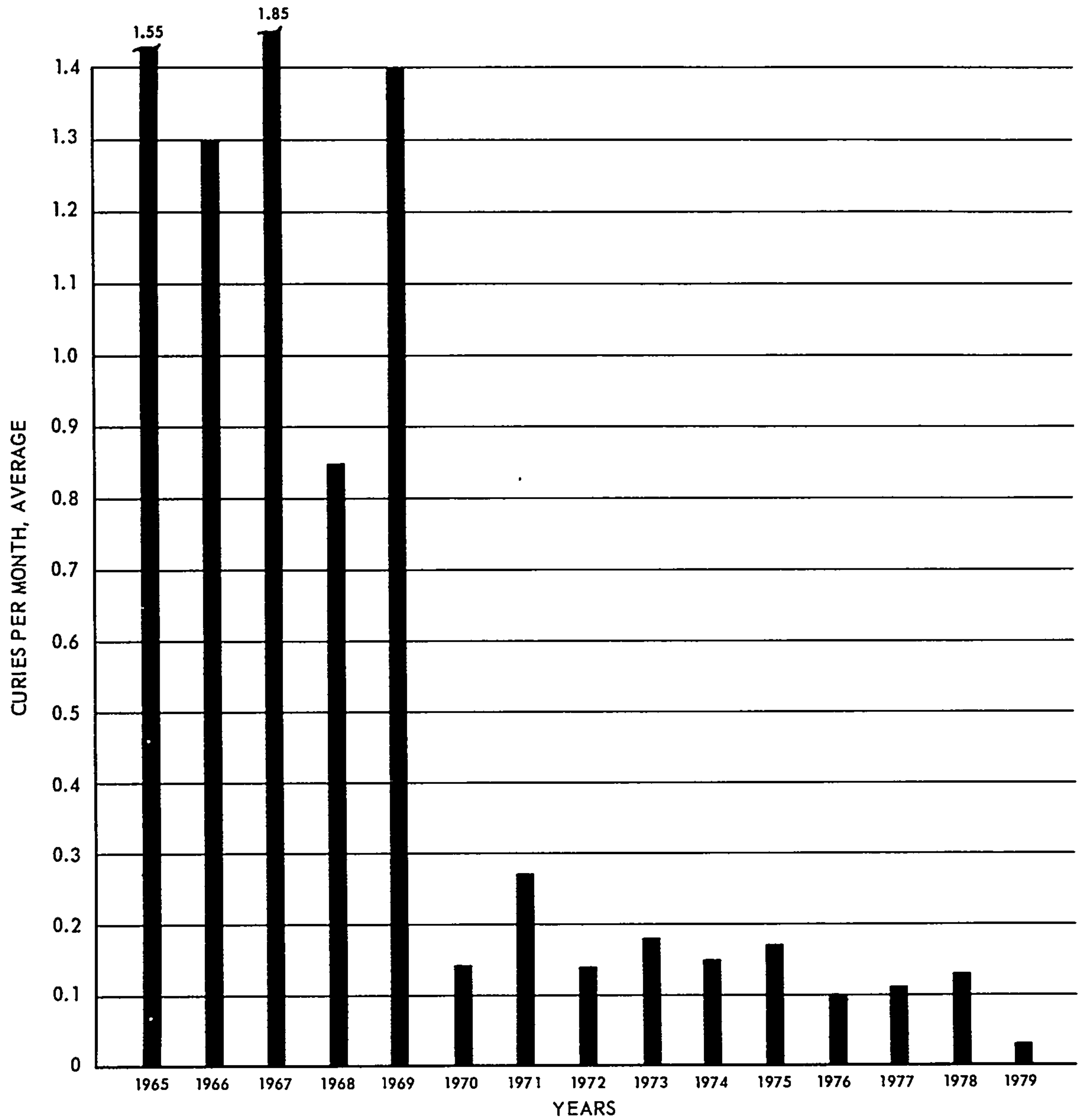


FIGURE 6.3-1
GASEOUS RELEASES
MONTHLY AVERAGES PER YEAR (MAINLY I-131)

TABLE 6.3-2

NOBLE GASES RELEASED FROM STACK 3039
(CG PERCENTAGE)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
January	< .64	< 1.5	< 2.0	< 1.4	< 1.9	< 1.5	< 2.4	< 0.3	< 1.6	< 1.3
February	< 1.61	< 1.8	< 1.6	< 1.2	< 2.3	< 2.2	< 2.3	< 0.5	< 1.5	< 1.5
March	< 2.08	< 1.5	< 1.8	< 1.4	< 1.1	< 2.3	< 1.9	< 1.1	< 1.6	< 1.3
April	< 1.7	< 1.7	< 1.6	< 1.4	< 2.1	< 2.7	< 1.5	< 1.1	< 0.9	< 0.8
May	< 2.0	< 1.9	< 1.8	< 1.5	< 2.8	< 2.2	< 1.5	< 0.7	< 0.9	< 1.1
June	< 1.7	< 1.7	< 2.0	< 1.6	< 2.6	< 2.0	< 1.5	< 0.5	< 1.2	< 1.8
July	< 1.7	< 1.6	< 1.1	< 1.9	< 2.2	< 2.7	< 1.6	< 1.8	< 1.9	
August	< 2.5	< 1.5	< 1.4	< 1.0	< 2.3	< 1.8	< 0.7	< 0.8	< 1.5	
September	< 2.0	< 2.1	< 1.5	< 1.5	< 3.2	< 1.8	< 1.0	< 1.0	< 1.2	
October	< 2.3	< 1.5	< 1.7	< 1.6	< 2.8	< 1.9	< 0.7	< 0.8	< 1.3	
November	< 1.9	< 1.6	< 1.8	< 1.9	No Record	< 2.2	< 0.6	< 0.7	< 1.2	
December	< 1.7	< 1.5	< 2.0	< 2.2	< 2.7	< 2.3	< 0.6	< 1.3	< 1.3	

NOBLE GASES RELEASED FROM STACK 7911
(CG PERCENTAGE)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
January	< 0.11	< 0.3	< 0.3	< 0.5	< 0.3	< 0.2	< 0.4	< 0.4	< 0.6	< 0.3
February	< 0.09	< 0.3	< 0.3	< 0.6	< 0.3	< 0.3	< 0.2	< 0.4	< 0.2	< 0.3
March	< 0.17	< 0.3	< 0.4	< 0.3	< 0.3	< 0.5	< 0.3	< 0.2	< 0.2	< 0.2
April	< 0.4	< 0.3	< 0.3	< 0.3	< 0.2	< 0.2	< 0.3	< 0.2	< 0.2	< 0.3
May	< 0.2	< 0.4	< 0.4	< 0.3	< 0.2	< 0.3	< 0.3	< 0.2	< 0.2	< 0.33
June	< 0.1	< 0.3	< 0.2	< 0.2	< 0.2	< 0.5	< 0.2	< 0.2	< 0.2	< 0.3
July	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.2	
August	< 0.4	< 0.2	< 0.2	< 0.3	< 0.2	< 0.1	< 0.2	< 0.4	< 0.2	
September	< 0.3	< 0.2	< 0.2	< 0.4	< 0.8	< 0.2	< 0.5	< 0.8	< 0.2	
October	< 0.1	< 0.2	< 0.6	< 0.4	< 0.2	< 0.2	< 0.4	< 0.2	< 0.2	
November	< 0.6	< 0.4	< 0.9	< 0.2	No Record	< 0.2	< 0.3	< 0.1	< 0.3	
December	< 0.3	< 0.5	< 0.5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	

Note: Noble gas discharges to atmosphere in 1976 are estimated to be: Xe-133 - <56,000Ci; Kr-85 - <11,000Ci. These are upper limit values based on direct radiation instrument measurements in the stack gas stream and an assumed mixture of noble gases.

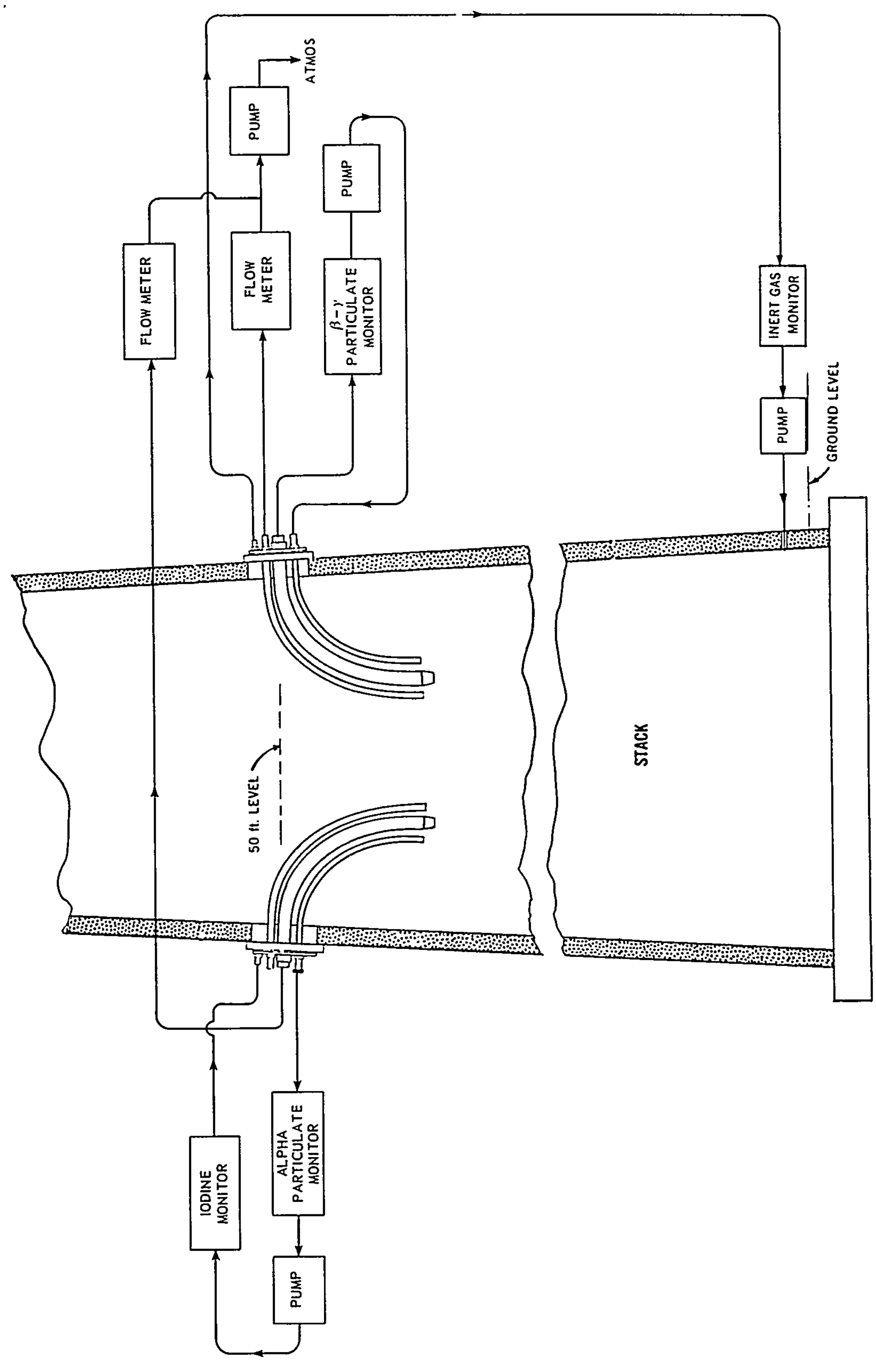


FIGURE 6.4-1
3039 STACK MONITOR LOCATIONS

TABLE 6.4-1

GASEOUS WASTE DISPOSAL SYSTEM
RADIATION MONITOR LOCATIONS

Stack	Stack Monitors: High Level	Stack Monitors: Alpha Particulate	Stack Monitors: Beta-Gamma Particulate	Stack Monitors: Iodine	Stack Monitors: Sampler - 2	Stack Monitors: Inert-Gas	Duct Monitors: Beta-Gamma Particulate (Source)	Duct Monitors: Flowrate	Stack Monitors: Flowrate
3039 (Primary)		X	X	X	X	X	Bldg. 3025/3025	X	X
							3500 Area	X	
							Isotope Area (Bldg. 3110)	X	
							4500 Area	X	
							Main-off gas System		
7911 (Melton Valley)	X	X	X	X	X	X	HFIR	X	X
							TURF	X	
							TRU	X	
7503 (MSRE)		X	X	X	X	X			X
3020		X	X	X	X	X			X
2026 (HRLAL)			X		X	X			
6010 (ORELA)			X			X			

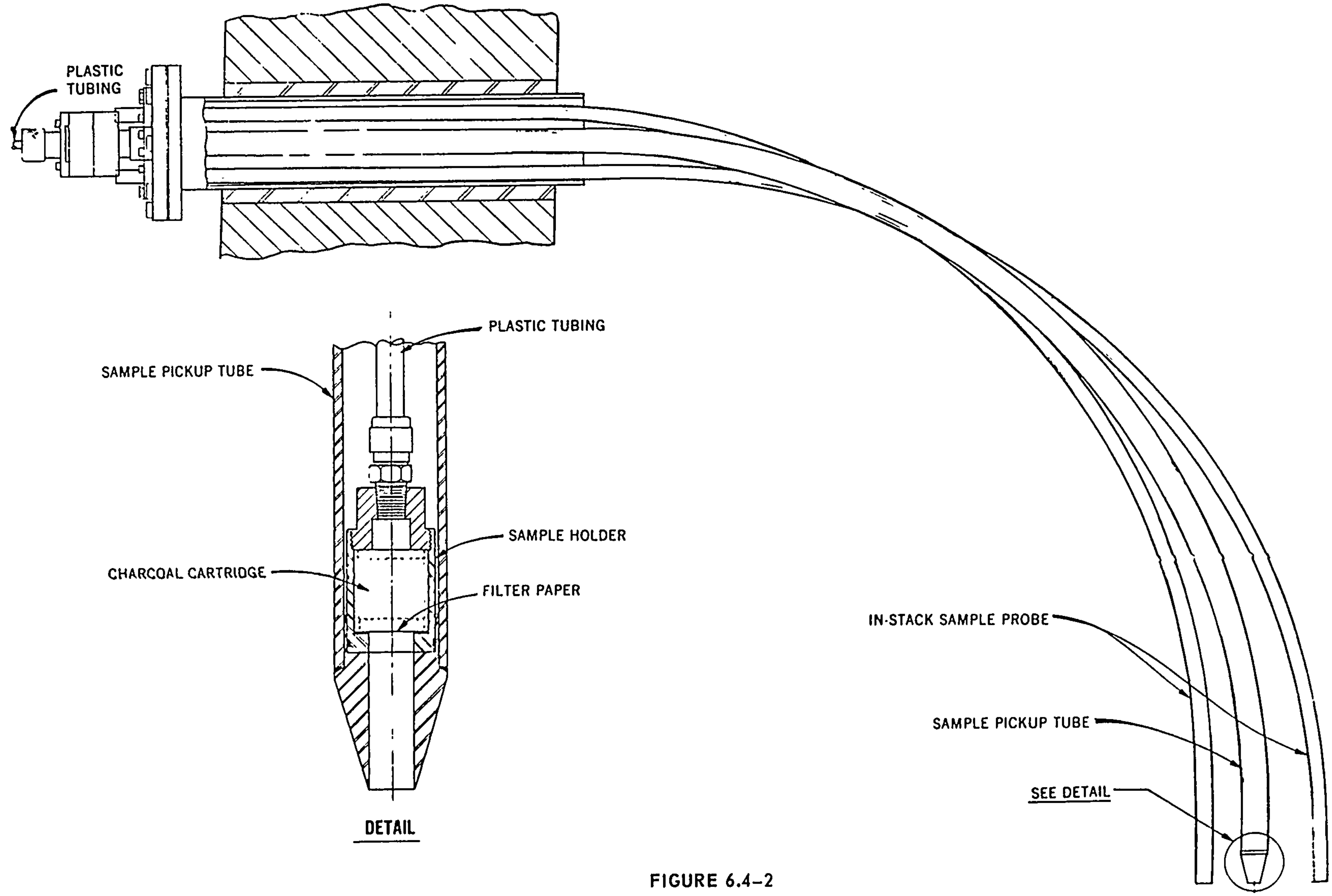


FIGURE 6.4-2
IN-STACK SAMPLER ASSEMBLY

In the other stacks and ducts, where count rate meters are located external to the Control Complex, a signal is telemetered to the Complex for recording and/or alarm. Alarms indicate high radiation, inoperation, tape break, or pump failure. The following table (6.4-2) lists the locations of stack monitors and ratemeters on stacks other than 3039.

TABLE 6.4-2

STACK MONITOR AND RATEMETER LOCATIONS

Stack	Stack Monitor Location	Ratemeter Location
7911	Platform at 50 ft stack level	HFIR Auxliary Control Room
3020	Platform at 55 ft stack level	Building 3082
2026	Duct from High Radiation Level Analytical Laboratory	Building 2026
6010	Duct from Electron Linear Accelerator	Building 6010
7503	Platform at 40 ft stack level	Building 7503

6.5 RECOMMENDATIONS/CONCLUSIONS

- A comprehensive review of all gaseous waste sources should be conducted. This review should include 1) identification of source points, 2) evaluation of source treatment practices, 3) identification of releases in terms of isotopic content and quantities, and 4) cost/benefit of localized gas holdup systems.

- The present gaseous effluent sample withdrawal method used at Stack 3039 is only marginally acceptable. By current design practices, ORNL methods are undesirable (Table 6.5-1). The present design employed by ORNL attempts to achieve representative sampling isokinetically. However, due to varying flowrates into the stack from user facilities, and changing air flow velocity patterns across the stack, isokinetic sampling is not achieved. ORNL is most likely using maximum calculated stack flowrate rather than actual flowrate. Since the 3039 stack will remain unaltered

TABLE 6.5-1

3039 STACK SAMPLING ASSESSMENT

Requirements and Considerations ANSI N13.1(1969)	ORNL Current Practices	Conclusion
Sample must be representative:		
o Sufficient number of sample points	o Single probe	o Unacceptable by 1979 design practices
o Proper probe placement 8-10 duct diameters downstream of inlets and 3-5 duct diameter upstream of outlets.	o 50 ft elevation	o Unacceptable by 1979 design practices
Isokinetic sampling is desirable or near-isokinetic	Non-isokinetic	Unacceptable by 1979 design practices
Long sample lines must be avoided; minimum bends	Equipment located on platform at 50 ft level	Acceptable
(>10 dia. bending radius)	<10 dia. bending radius	Undesirable
Air patterns fully developed at sample point	Sample point at 50 ft elevation	Undesirable
Adequate sample probe design	Yes	Acceptable
Evaluation of line losses is required	Unknown	Analysis should be undertaken

after the proposed ventilation alterations by Sanders and Thomas, Inc. (Project No. 80-ORNL-16), it is recommended that a detailed design study be undertaken to specify the design of an auto-isokinetic sampling and flow monitoring system. The system would be required to measure and accurately totalize the actual stack flow, withdraw an isokinetic representative sample from the effluent air stream, automatically maintain isokinetic sampling under varying flowrate conditions, and transfer the sample gas to a radiation monitor for continuous measurement of radioactivity. Figure 6.5-1 provides an example of the type of system that could be used.

- Maintenance activity and routine sample filter cartridge changes on equipment located at the 3039 stack 50 ft elevation are hazardous to personnel. Personnel must climb the stack via installed ladder and convey components to the 50 ft platform via rope and bucket in order to accomplish maintenance or routine changeout of inventory samples. In winter, icy ladders and platforms are hazardous to involved personnel. Maintenance at night or during inclement weather is also hazardous. Most other ORNL stack monitoring systems have this same problem. A design study should be undertaken to investigate placing monitoring and sampling equipment in an instrument house located at the base of the stack.

- The current monitoring and sampling equipment is old and requires high maintenance. Even though it accomplishes its basic function, it is recommended that a study be performed to determine the cost/benefit of equipment changeout. A prudent renovation scheme integrated to the computerized data acquisition system would provide long term benefits.

6.6 REFERENCES

1. Sanders and Thomas Inc., Off-gas and Cell Ventilation Improvements, Conceptual Design Report prepared for Oak Ridge National Laboratory, November 6, 1978.

2. Oak Ridge National Laboratory, "Description of Waste Management Operations," July 10, 1970.

3. Oak Ridge National Laboratory, "Radioactive Gaseous Effluent Monitoring and Sampling at the Oak Ridge National Laboratory," prepared by the Instrumentation and Controls Division for Safety and Radiation Control, April 30, 1970.

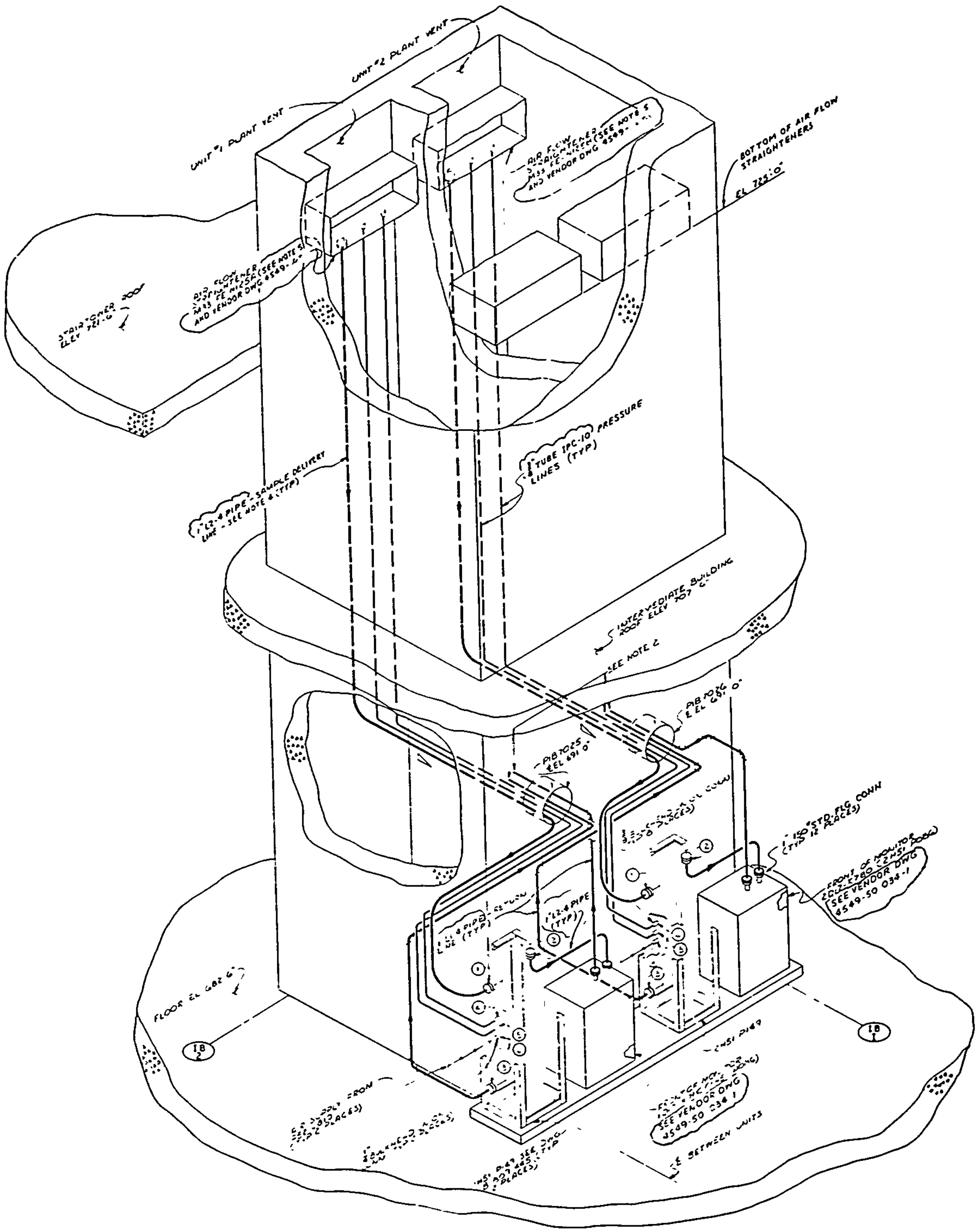


FIGURE 6.5-1
EXAMPLE OF TWIN STACK MONITORING

SECTION 7.0
MONITOR/CONTROL COMPLEX

7.1 EXISTING OPERATIONS

The Waste Operations Control Complex is located in Building 3105. The building contains a small instrument shop, some office space, and two rows (north and south) of vertical control panels consisting of a total of approximately 30 lineal ft of control board. The control center uses instrumentation for monitoring and recording and audible and visual alarms for surveillance of the liquid and gaseous waste disposal systems at ORNL. Remote instrumentation channels are telemetered to the Control Complex. A shift operator is on duty providing round-the-clock surveillance.

In the event of an abnormal activity release or an exceeded operating limit, the shift operator must alert supervision and the respective facility so that corrective steps can be immediately taken.

The type of data monitored at the control center is summarized as follows:

- Wind direction, velocity, temperature
- Stack and duct gaseous effluent flowrate
- Local air monitor radioactivity
- Stack and duct gaseous effluent radioactivity
- Stack and duct radiation monitor alarm modules
- Cell blower status
- pH, oxygen temperature
- Process waste water flow rate
- Process waste water radioactivity
- OR-ILW tank levels
- Evaporator foam level alarms

7.2 RECOMMENDATIONS/CONCLUSIONS

A comprehensive study should be undertaken to assess and determine the extent to which ORNL may use a computerized data acquisition system as a replacement for existing hardware.

The Control Complex consists of old, large, current consumptive, heat producing, high maintenance components such as:

- Large case multipoint strip chart recorders and small pen-type Rustrack recorders. These recorders use large quantities of chart paper which must be stored and retrieved on demand. Inking is always a problem. In addition, the chart paper guide scales are not correlated to the range of the instrument. Reading of the chart is inaccurate and difficult.

- Contact-type meters are used on count-rate meters for alarm functions. These can become problem areas due to sticking upon actuation.

- Peg board status is employed for remote count-rate meter range status.

These components are, to a large extent, difficult to read and correlate. Equipment renovation appears to be inevitable. However, the present design and existing hardware functions and serves its purpose. A computerized data acquisition and logging system appears to be the prudent course of action for renovation. This kind of system is costly but can be an extremely flexible and powerful tool. An analysis of the exact extent of the intended usage both in the immediate and long range future must be made in order to ensure that adequate and proper equipment is procured. In addition, other ORNL associated activities should be investigated at to determine possible integration into this system. Other possible uses for this sytem are: 1) computation, 2) report generation, 3) trending, 4) maintenance record-keeping, 5) X-Y plotting, 6) isotopic inventorying, and 7) health physics record-keeping. A conceptual system is described in Appendix B.

APPENDIX A

RADIOACTIVE WASTE MANAGEMENT PLAN

(Outline)

1.0 INTRODUCTION

1.1 BACKGROUND AND TERMINOLOGY

1.2 PURPOSE OF PLAN

1.3 OBJECTIVES

1.4 POLICIES AND CRITERIA

1.4.1 Regulatory

1.4.2 Administrative

2.0 PROGRAM ADMINISTRATION

2.1 SITE

(Description of the various divisions and operations of ORNL with regard to radioactive waste management.)

2.2 OFFICE RESPONSIBLE

(Identification and organizational description of the DOE field office responsible for directing/overseeing the ORNL site operations and activities.)

2.3 CONTRACTORS

(Listing of prime contractor (UCC) and overall description of programs relevant to waste management operations; listing of subcontractors for programs related to waste management operations.)

2.4 LEAD RESPONSIBILITY FOR SITE PLANS

(Identify contractor and division responsible for development and updating of site plans; responsibility to other DOE contractors related to waste management operations.)

2.5 SOURCE OF FY 1980 FUNDS FOR WASTE MANAGEMENT

[Sources and Funding for 1) Operations, 2) Technology Development, 3) Capital Projects and Improvements].

3.0 DESCRIPTION OF WASTE GENERATING PROCESSES

For each radioactive waste generating process (X,Y,Z etc.) within each facility (A,B,C etc.), the following should be documented:

3.1 FACILITIES (A,B,C etc.)

3.1.1 Processes (X,Y,Z etc.)

- Waste Forms/Classifications
- Waste Generating Operations and Flowcharts
- Quantities/Activity
- Isotopic Content
- Physical/Chemical Properties
- Past History and Future Projections of Waste Generation

4.0 DESCRIPTION OF WASTE MANAGEMENT FACILITIES

4.1 LIQUID WASTES

4.1.1 Low Level

4.1.1.1 Identification and Location of Facilities for Collection, Treatment, Storage, and Disposal

4.1.1.2 Description of Collection and Treatment Processes

(Included are flow diagrams and listing of criteria and procedures for collection, processing, sampling, monitoring, and personnel protection.)

4.1.1.3 Description of Waste Storage/Disposal Practices

(Listing of criteria and procedures for storage, surveillance/retrieval, and disposal.)

4.1.1.4 Effluent Control

(Included are a description of criteria and procedures.)

4.1.1.5 Administrative Limits on Effluents

(Discussion and justification for selection of limits.)

4.1.2 Intermediate Level

(Same subheadings as 4.1.1 except subsections 4.1.1.4 and 4.1.1.5 are deleted.)

4.1.3 High Level

(Same subheadings as 4.1.1 except subsections 4.1.1.4 and 4.1.1.5 are deleted.)

4.1.4 TRU

(Same subheadings as 4.1.1 except subsections 4.1.1.4 and 4.1.1.5 are deleted.)

4.2 SOLID WASTE

4.2.1 Low Level (all types)

4.2.1.1 Identification and Location of Facilities for Collection Treatment, Storage, and Disposal

4.2.1.2 Description of Collection and Treatment Processes

(Included are flow diagrams and a listing of criteria and procedures for collection, processing, monitoring, and personnel protection.)

4.2.1.3 Description of Waste Storage/Disposal Practices

(Listing of criteria and procedures for storage, surveillance/retrieval and disposal.)

4.2.2 Transuranics (>10nC/gm)

(Same subheadings as 4.2.1.)

4.2.3 Special (non-TRU, fissile, high specific activity, etc.)

(Same subheadings as 4.2.1.)

4.3 GASEOUS WASTES

(Same subheadings as 4.2.1.)

5.0 <u>ON-SITE RADIOACTIVE WASTE STORED/DISPOSED</u>

5.1 STORED HIGH LEVEL WASTE FROM CHEMICAL PROCESSING AND RESEARCH OPERATIONS

5.1.1 Identification and Location

5.1.2 Retention Device/Facility/Medium

5.1.3 Inventory - (Quantitative/Qualitative)

5.1.4 Retrieval Plans

5.2 STORED RADIOACTIVE WASTES OTHER THAN SOLIDIFIED HIGH LEVEL WASTE

(Same subheadings as 5.1.)

5.3 OTHER STORED RADIOACTIVE MATERIALS

(Same subheadings as 5.1.)

5.4 DISPOSED RADIOACTIVE WASTE

(Same subheadings as 5.1 except 5.1.4 is deleted.)

6.0 DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

(Listing of radioactively contaminated facilities declared surplus as of FY 1980.)

7.0 PLANS AND BUDGET PROJECTIONS

7.1 INTERIM STORAGE OF HIGH-LEVEL LIQUID WASTE

7.1.1 Milestone Charts

7.1.2 Expected Accomplishments in FY 1980

7.1.3 Proposed Program for FY 1981

7.1.4 Proposed Programs for FY 1982 and Beyond

7.1.5 Five-Year Budget Projections for FY 1982 and Beyond

7.2 LONG-TERM STORAGE OF HIGH LEVEL WASTE

(Same subheadings as 7.1.)

7.3 DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

(Same subheadings as 7.1.)

7.4 MANAGEMENT OF LOW AND INTERMEDIATE LEVEL LIQUID WASTE

(Same subheadings as 7.1.)

7.5 MANAGEMENT OF SOLID WASTE CONTAMINATED WITH RADIOACTIVITY

(Same subheadings as 7.1.)

7.6 MANAGEMENT OF RADIOACTIVE WASTE DISPOSED ON-SITE

(Same subheadings as 7.1.)

7.7 MANAGEMENT OF AIRBORNE RADIOACTIVE WASTE

(Same subheadings as 7.1.)

7.8 SUMMARY OF BUDGET PROJECTIONS

(Included are capital costs for facility improvements, decontamination and decommissioning costs, research and development costs, and operations costs.)

APPENDIX B

COMPUTER BASED DATA ACQUISITION SYSTEM

This appendix presents a brief outline of a conceptual design for a computer based data acquisition system which could be used at the Waste Operation Control Complex (Building 3105).

The primary function of this system would be to gather and store specific environmental, radiological, and waste facility operating data. In addition, personnel radiological exposure records, radwaste inventory records, and radiation monitoring equipment calibration and maintenance records would also be stored. The computer system would be used by both operations and health physics personnel for data logging, computation, record generation, trending, alarm, and display of variables. The system would include all the executive, operating, and application software necessary to accomplish all functions. Software would provide flexibility for program modification. A system outline is shown in Figure B-1.

It is assumed that all radiation monitoring channel count-rate meters are located locally and would have been renovated to a solid state circuit design. In addition, it is assumed that status lights, and multipoint recorders are not used in the design.

Specific inputs would be as follows.

- o Meterological data (wind speed, direction, temperature).
- o Stack gaseous effluent radioactivity level.
- o Major duct airborne radioactivity level.
- o Radiation monitoring equipment alarms.
- o Local and perimeter air monitor radioactivity level.

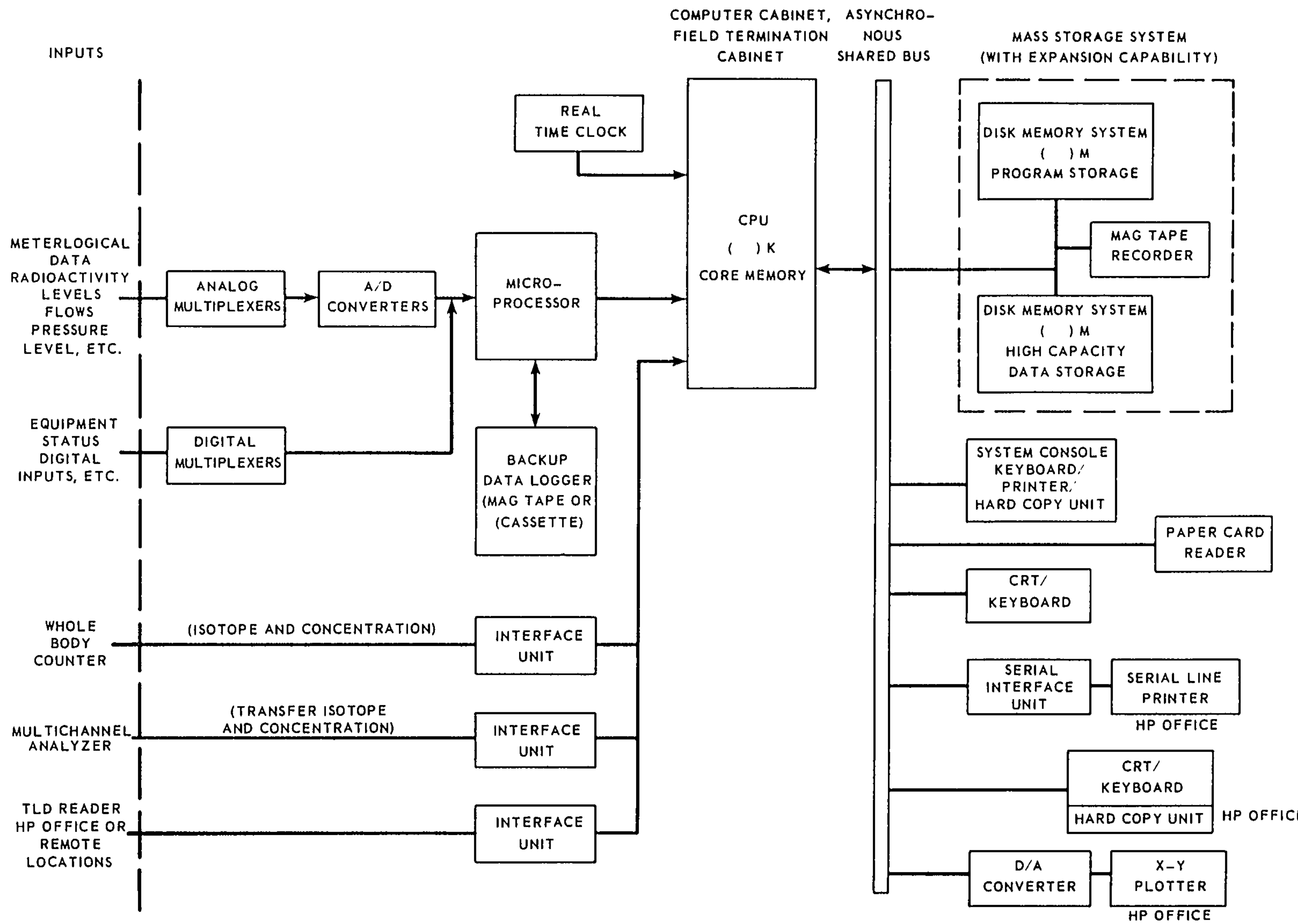


FIGURE B-1
ORNL CONCEPTUAL COMPUTER BASED DATA ACQUISITION
WASTE OPERATIONS CONTROL CENTER BUILDING 3105

- o Stack and major duct flowrate.
- o Low level (process) waste water stream flowrate and radioactivity level.
- o Liquid effluent flowrate and radioactivity level.
- o Evaporator system and treatment system atmospheric and process radioactivity levels.
- o ILW tank levels.
- o Process system component status and parameters.
- o Various security alarms.
- o Building containment status.
- o Whole body counter (isotope and concentration).
- o Multichannel analyzer (isotope and concentration).
- o TLD reader (occupational dose).
- o Other undefined inputs.
- o Card reader inputs.

Specific computer hardware would be as follows:

- o Analog and digital multiplexers, analog/digital converters, microprocessor, termination cabinets.
- o Magnetic tape unit.
- o Central processing unit (computer).

- Disk memory units (high capacity).

- Disk memory system.

- CRT terminal with keyboard.

- System console keyboard/printer.

- Serial printer.

- Card reader.

- X-Y plotter, hard copier.

Outline (see Figure B-1):

- All operator program changes will be recorded on magnetic tape.

- Data storage would consist of 1 hour average reading for continuous channels, isotopic composition data, and contract closures.

- Data storage has expansion capability.

- Health physics office would be equipped with a serial printer for report generation, a CRT/keyboard for computer integration, and an X-Y plotter.

The software package functions to provide data acquisition, data display, system control, report generation, and log generation.

Features:

- Trend display - X-Y display for effluent activity.

- o Report generation - tables required for reporting batch and continuous releases of radioactive isotopes to unrestricted areas

  - radwaste inventory tables

  - personnel exposure records

  - health physics survey information

  - maintenance and calibration records

- o Calculation of instantaneous release rates from individual points (stacks) or the entire ORNL facility.

- o Provides display and alarm functions for system surveillances.

APPENDIX C

AS LOW AS REASONABLY ACHIEVEABLE (ALARA) AUDIT AND PROGRAM

In the past several years, considerable emphasis has been placed on minimizing radiation doses to personnel within facilities and in the surrounding area. Recently the US Nuclear Regulatory Commission issued a draft letter for implementation of ALARA programs at licensees and for the review of the ALARA Program by regional inspectors of the Office of Inspection and Enforcement. Since such an ALARA program is implied in the DOE Manual Chapter 0524 on Radiation Protection, the Department of Energy may require the national laboratories and contractors to develop and implement an ALARA program. In light of our review of both current and future laboratory operations particularly in the areas of decontamination and decommissioning, it is recommended that an ALARA audit of ORNL radwaste operations be performed and that an ALARA program be developed to provide the framework within which future laboratory operations can be conducted.

3.1 ALARA AUDIT

The ALARA audit should be performed by a qualified health physics group, preferably independent of the laboratory. The ALARA audit should include the state of the art practices as expressed by regulatory bodies. The basic tasks associated with an ALARA audit are:

- Identification of radiation tasks.

- Correlation of radiological conditions with specific tasks.

- Correlation of manpower requirements with specific tasks.

- Review of available personnel dose and effluent release records and correlation with specific tasks.

- Selection of key tasks for further evaluation. Key tasks are those tasks which in their performance a significant man-rem dose is accumulated. Areas to consider further are:

  - Personnel training
  - Job site conditions
  - Influence of equipment layout and general area design on job performance.

- Review of procedures for key tasks.

- Recommendations for operational and design changes which will lower personnel radiation.

- Assessment of recommendations using a cost-benefit analysis.

C.2 ALARA PROGRAM

The ALARA program should be developed in conjunction with the radiation protection group at the laboratory. Information from the independent ALARA audit should be used in identifying problem areas, and the program must be responsive to the current philosophy regarding ALARA.

The tasks associated with an ALARA program would include all phases of operations at the laboratory. The program must include management personnel and the health physics organization for on-site and off-site operations. The program must develop data collection and review systems with which responsible personnel at the laboratory can be assured that radiation doses are ALARA.

The proposed ALARA program should include the following:

- Development/review of management organization to ensure ALARA radiation doses.

  - Management health physics structure
  - Management policies for maintaining radiation doses ALARA

- Personnel qualifications and responsibilities
- Data handling system
- Interface between management and operational health physics group

o Development/review of health physics organization for both in plant and environmental operations.

- Structure
- Policies and procedures to maintain radiation doses ALARA
- Personnel qualifications and responsibilities
- Interfaces between health physics group and other departments
- Data handling, analyses and feedback systems for identification of radiological problems and for maintaining radiation doses ALARA
- Quality control program
- Health physics program

  . Facilities
  . Instrumentation and Equipment

    Portable
    Stationary
    Personnel monitoring equipment
    Emergency equipment

o Extent and utilization of procedures

- Normal operation
- Emergency conditions

o Training

APPENDIX D

LLW MAJOR CONTRIBUTOR'S MONTHLY AVERAGE ACTIVITIES AND VOLUMES

TABLE D-1A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1970
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	390	130	320	500	440	440	180	60	170	350	330	350	305
Area (MH114-MH112) MH112	630	570	600	670	520	380	150	110	880	990	590	760	570.8
Bldg. 3503 & 3508	80	30	30	50	30	-	20	10	30	40	30	40	35.5
Bldg. 3025 & 3026	30	10	30	20	20	20	10	-	10	<10	<10	10	16.4
Bldg. 3019	10	10	10	20	<10	<10	<10	<10	<10	<10	<10	10	10.8
Bldg. 2531	50	40	40	10	30	<10	20	<10	10	10	10	50	24.2
Bldg. 3525	10	10	10	20	10	<10	<10	<10	10	10	<10	<10	10.8
Bldg. 2026							<10		10	10	<10	<10	10.0
Tank Farm Drainage Bldg. 3505, 3517	10	70	80	160	30	40	<10	10	30	20	20	60	45
TOTAL	1210	870	1120	1450	1090	910	420	220	1160	1450	1020	1300	1028.5

TABLE D-1B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1970
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.64	.44	.66	.70	.82	1.03	.51	.40	.30	.47	.56	.51	.59
Area (MH114-MH112) MH112	4.63	4.28	3.71	3.00	2.69	1.21	1.19	1.60	2.00	2.05	1.34	1.30	2.50
Bldg. 3503 & 3508	.68	.61	.66	.70	.80	.76	.81	1.00	.60	.58	.45	.50	.68
Bldg. 3025 & 3026	2.19	.72	2.02	2.30	2.41	2.01	1.39	.90	.50	.67	.51	.46	1.34
Bldg. 3019	.42	.30	.36	.60	.63	.67	.32	.40	.20	.07	.07	.20	.37
Bldg. 2531	1.52	1.30	1.34	1.00	1.00	.99	.98	1.00	.70	.72	.71	.75	1.00
Bldg. 3525	.79	1.71	.79	.70	.65	.70	.72	.80	.80	.75	.67	.59	.81
Bldg. 2026							.03		.10	.13	.18	.23	.13
Tank Farm Drainage Bldg. 3505, 3517	.17	.13	.26	.30	.10	.13	.13	.20	.10	.03	.03	.90	.21
TOTAL	11.04	9.49	9.80	9.30	9.10	7.50	6.28	6.30	5.30	5.47	4.52	5.44	7.63

TABLE D-2A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1971
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	230	190	150	170	710	350	310	110					277.5
Area (MH114-MH112)													
MH112	730	980	1710	850	830	720	1020	650					936.3
Bldg. 3503 & 3508	30	40	40	40	80	20	60	50					45.0
Bldg. 3025 & 3026	<10	10	<10	<10	10	<10	20	10					11.3
Bldg. 3019	10	<10	<10	10	<10	<10	20	<10					11.3
Bldg. 2531	30	20	30	510	60	10	20	20					87.5
Bldg. 3525	<10	<10	<10	<10	<10	<10	<10	<10					10.0
Bldg. 2026	<10	<10	<10	<10	<10	<10	<10	14					10.5
Tank Farm Drainage													
Bldg. 3505, 3517	60	60	30	10	20	<10	20	<10					27.5
TOTAL	1120	1330	1000	1620	1740	1150	1490	884					1291.8

TABLE D-2B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1971
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.52	.33	.23	.22	.27	.16	.13	.08					.24
Area (MH114-MH112)													
MH112	1.16	1.88	2.09	1.16	.97	.89	1.16	1.08					1.36
Bldg. 3503 & 3508	.51	.66	.60	.69	.75	.68	.79	.54					.65
Bldg. 3025 & 3026	.61	1.12	1.31	.44	.20	.20	.27	.38					.57
Bldg. 3019	.06	.05	.10	.14	.07	.18	.05	.05					.09
Bldg. 2531	.70	.74	.81	.73	.75	.55	.58	.72					.70
Bldg. 3525	.62	.47	.46	.31	.17	.37	.50	.44					.42
Bldg. 2026	.25	.25	.19	.19	.25	.32	.22	.22					.24
Tank Farm Drainage													
Bldg. 3505, 3517	.17	.16	.10	.07	.07	.09	.10	.07					.10
TOTAL	5.10	5.60	5.89	3.95	3.50	3.44	3.80	3.58					4.37

TABLE D-2C

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1971
(Sr-90, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)			110	70	190	140	130	40	150	50	80	90	105.0
Area (MH114-MH112)									370	550	250	260	357.5
MH112			970	460	360	380	500	350	<10	<10	<10	<10	306.0
Bldg. 3503 & 3508			20	20	30	40	20	20	30	30	20	30	26.0
Bldg. 3025 & 3026			<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	9.1
Bldg. 3019			<5	<10	<10	<10	<10	<10	20	<10	<10	<10	10.5
Bldg. 2531			10	10	10	10	20	30	120	150	90	3600	405.0
Bldg. 3525			10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2026			0	<10	<10	<10	<10	20	<10	<10	<10	<10	10.0
Tank Farm Drainage Bldg. 3505, 3517			20	<10	10	10	<10	-	<10	<10	<10	<10	10.0
TOTAL			1146	610	640	620	720	490	740	840	500	4040	1249.1

TABLE D-2D

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1971
(Sr-90, MILLIONS OF GALLONS)

	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.23	.223	.27	.16	.13	.08	.10	.06	.14	.16	.16
Area (MH114-MH112)							.81	.69	.94	1.00	.86
MH112	2.09	1.16	.97	.89	1.16	1.08	.38	.32	.30	.38	.87
Bldg. 3503 & 3508	.60	.69	.75	.68	.79	.54	.84	.90	1.13	1.04	.80
Bldg. 3025 & 3026	1.31	.44	.201	.20	.27	.38	.34	.21	.18	.27	.38
Bldg. 3019	.10	.14	.07	.18	.05	.05	.05	.08	.03	.01	.08
Bldg. 2531	.81	.73	.75	.55	.58	.72	.98	1.23	1.43	.95	.87
Bldg. 3525	.46	.31	.17	.37	.50	.44	.36	.44	.38	.59	.40
Bldg. 2026	.19	.19	.25	.32	.22	.22	.21	.22	.21	.19	.22
Tank Farm Drainage Bldg. 3505, 3517	.10	.07	.07	.09	.10	.07	.11	.05	.03	.04	.07
TOTAL	5.89	3.95	3.50	3.44	3.80	3.58	4.18	4.20	4.77	4.59	4.71

TABLE D-3A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1972
(Sr-90, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	190	120	20	10	10	30	21	40	30	40	20	40	47.5
Area (MH114-MH112)	160	310	310	370	360	410	420	410	200	330	270	460	334.2
MH112	-	-	<10	<10	<10	10	<10	10	<10	<10	<10	<10	10.0
Bldg. 3503 & 3508	30	30	30	20	30	40	60	40	40	70	30	100	43.3
Bldg. 3025 & 3026	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 3019	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2531	940	380	220	340	30	60	40	60	80	40	170	210	214.2
Bldg. 3525	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2026	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	10.8
Tank Farm Drainage													
Bldg. 3505, 3517	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	110	18.3
TOTAL	1370	890	780	920	630	680	610	730	520	740	630	1340	842.3

TABLE D-3B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1972
(Sr-90, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.36	.52	.06	.04	.05	.07	.06	.16	.26	.26	.14	.16	.18
Area (MH114-MH112)	.67	.57	.48	.62	.78	.86	.97	.76	.45	.61	.33	.36	.62
MH112	-	-	.33	.27	.34	.33	.40	.45	.27	.47	.59	.81	.43
Bldg. 3503 & 3508	.98	1.06	1.07	.78	1.01	1.00	1.07	.93	.85	1.13	1.05	1.29	1.02
Bldg. 3025 & 3026	.53	.28	.26	.23	.20	.20	.26	.32	.37	.80	.66	.61	.39
Bldg. 3019	.03	.12	.11	.11	.03	.03	.02	.04	.05	.04	.11	.22	.08
Bldg. 2531	1.24	1.01	1.03	.99	.88	.20	.92	.71	.56	.49	.70	1.07	.82
Bldg. 3525	.73	.58	.78	.82	.84	.72	.87	.84	.83	.76	.82	.76	.78
Bldg. 2026	.20	.19	.19	.19	.21	.20	.16	.15	.16	.19	.15	.19	.18
Tank Farm Drainage			.80	.80	.85	.68	.71	.71	.59	.90	.90	1.26	.82
Bldg. 3505, 3517	.03	.03	.03	.03	.03	.03	.01	.02	.02	.02	.02	.01	.02
TOTAL	4.77	4.36	5.14	4.88	5.22	4.32	5.45	5.09	4.41	5.67	5.47	6.74	5.34

TABLE D-4A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1973
(GROSS BETA, MILLICURIES)

	Jan.*	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	30	40	<10	100	90	80	30	50	40	70	50	50	55.5
Area (MH114-MH112)	140	140	130	420	500	180	50	230	260	250	280	370	255.5
MH112	<10	<10	10	<10	10	10	40	40	20	10	10	10	16.4
Bldg. 3503 & 3508	100	130	130	<10	140	110	390	90	80	90	80	220	133.6
Bldg. 3025 & 3026	<10	<10	10	60	10	<10	<10	<10	<10	<10	<10	<10	14.5
Bldg. 3019	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2531	60	-	200	1360	610	50	290	10	80	-	30	130	306.7
Bldg. 3525	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2026	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	<10	10.8
Tank Farm Drainage	330	460	200	290	510	330	220	190	130	220	280	210	276.4
Bldg. 3505, 3517	<10	-	-	-	<10	<10	<10	-	<10	<10	<10	<10	10.0
TOTAL	720	820	720	2280	1910	800	1070	650	660	690	780	1040	

TABLE D-4B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1973
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.*	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.12	.10	.18	.12	.12	.12	.12	.08	.06	.11	.10	.06	.11
Area (MH114-MH112)	.38	.45	.68	.46	.39	.36	.23	.37	.55	.25	.29	.48	.41
MH112	.31	.19	.39	.33	.50	.30	.55	.51	.36	.36	.48	.83	.46
Bldg. 3503 & 3508	1.16	1.09	1.12	.93	1.05	.91	.91	.96	.96	1.00	1.05	1.14	1.01
Bldg. 3025 & 3026	.45	.41	.48	.49	.73	.46	.44	.31	.34	.36	.29	.25	.42
Bldg. 3019	.13	.05	.07	.05	.09	.04	.03	.09	.13	.09	.15	.19	.09
Bldg. 2531	.53	.77	.80	.56	.55	.43	.47	.56	.52	.59	.48	.44	.56
Bldg. 3525	.77	.79	.73	.63	.62	.42	.48	.31	.34	.56	.26	.07	.47
Bldg. 2026	.23	.19	.19	.11	.11	.13	.18	.16	.12	.12	.12	.14	.14
Tank Farm Drainage	1.14	1.05	1.28	1.03	1.12	.95	.93	.89	.77	.80	1.00	1.56	1.03
Bldg. 3505, 3517	.01	.01	.01	.01	.01	.01	.01	.56	.01	.02	.02	<.01	.06
TOTAL	5.23	5.10	5.92	4.72	5.29	4.13	4.34	4.80	4.16	4.26	4.24	5.17	4.76

*Sr-90.

TABLE D-5A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1974
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	30	40	40	30	40	30	30	60	30	40	60	50	40.0
Area (MH114-MH112)	340	190	180	310	210	320	250	260	190	170	170	210	225.0
MH112	380	20	40	<10	<10	<10	<10	<10	<10	<10	<10	<10	44.2
Bldg. 3503 & 3508	200	200	270	60	<10	<10	<10	<10	<10	<10	<10	<10	67.5
Bldg. 3025 & 3026	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 3019	10	<10	<10	<10	<10	<10	<10	<10	<10	10	20	<10	10.8
Bldg. 2531	20	70	30	10	20	30	50	30	60	30	50	20	35.0
Bldg. 3525	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Bldg. 2026	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
Tank Farm Drainage	530	370	80	210	210	180	180	200	180	140	160	290	227.5
Bldg. 3505, 3517	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10.0
TOTAL	1550	940	690	680	550	530	580	620	530	450	520	640	690.0

TABLE D-5B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1974
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.05	.06	.09	.05	.08	.05	.09	.07	.04	.05	.07	.07	.06
Area (MH114-MH112)	.66	.29	.37	.50	.41	.43	.37	.43	.33	.27	.30	.20	.38
MH112	.45	.51	.55	.37	.37	.37	.35	.45	.54	.47	.56	.87	.49
Bldg. 3503 & 3508	1.14	1.22	1.06	.40	.19	.24	.23	.22	.27	.32	.24	.13	.47
Bldg. 3025 & 3026	.22	.01	.21	.21	.21	.18	.21	.28	.37	.19	.22	.27	.22
Bldg. 3019	.15	.15	.19	.22	.16	.37	.43	.27	.39	.53	.48	.34	.31
Bldg. 2531	.43	.34	.49	.23	.37	.27	.47	.65	.58	.55	.61	.65	.47
Bldg. 3525	.05	.07	.04	.07	.02	.02	.03	.06	.04	.03	.07	.03	.04
Bldg. 2026	.17	.15	.17	.13	.16	.19	.21	.17	.14	.14	.20	.18	.17
Tank Farm Drainage	1.86	1.57	1.42	1.13	1.30	.90	.81	.73	.78	.62	.65	.52	1.02
Bldg. 3505, 3517	.02	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	<.01	.01
TOTAL	5.20	4.38	4.60	3.32	3.28	3.03	3.21	3.34	3.49	3.18	3.41	3.27	3.64

TABLE D-6A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1975
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	40	40	80	70	60	110	50	60	390	40	86	54	90.0
Area (MH114-MH112)	260	200	340	140	170	220	250	130	180	256	218	226	215.8
MH112	20	20	50	20	30	30	30	20	28	20	9	1	23.2
Bldg. 3503 & 3508	<10	<10	<10	<10	<10	<10	<10	<1	4	3	0	<1	6.6
Bldg. 3025 & 3026	<10	<10	10	<10	<10	<10	30	<10	2	4	3	3	9.3
Bldg. 3019	20	≤20	10	10	10	<10	≤10	≤10	≤6	≤4	10	15	11.25
Bldg. 2531	20	20	10	20	20	130	70	30	19	444	132	62	81.4
Bldg. 3525	<10	<10	<10	<10	<10	<10	<10	<10	14	1	<1	<1	8.1
Bldg. 2026	<10	<10	<10	<10	<10	-	<10	<10	1	0	2	<1	6.2
Tank Farm Drainage	520	500	480	210	210	310	240	160	245	432	340	559	350.5
Bldg. 3505, 3517	<10	<10	<10	<10	<10	<10	<10	<10	-	-	-	-	10.0
TOTAL	920	850	1020	520	550	850	720	451	889	1204	801	923	812.35

TABLE D-6B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1975
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.05	.05	.08	.08	.08	.07	.06	.08	.06	.05	.13	.08	.07
Area (MH114-MH112)	.27	.28	.16	.15	.07	.14	.10	.10	.11	.21	.15	.10	.15
MH112	.69	.45	1.12	.51	.96	.86	.72	.60	.71	.64	.44	.60	.69
Bldg. 3503 & 3508	.37	.27	.20	.17	.32	.33	.53	.35	.10	.10	.07	.35	.26
Bldg. 3025 & 3026	.37	.42	.49	.44	.35	.36	.22	.30	.27	.31	.26	.30	.84
Bldg. 3019	.49	.76	1.07	.95	.62	.66	.98	.92	.73	.66	.52	.92	.77
Bldg. 2531	.85	.57	.94	.71	.56	.86	.77	.68	.87	.54	.53	.68	.71
Bldg. 3525	.02	.02	.01	.02	.02	.02	.02	.02	.03	.05	.06	.02	.03
Bldg. 2026	.14	.11	.11	.12	.15	-	.11	.10	.14	.16	.16	.10	.12
Tank Farm Drainage	1.07	.91	.84	.75	.70	.65	.68	.69	.84	.87	.81	.69	.79
Bldg. 3505, 3517	<.01	<.01	.01	<.01	.01	<.01	<.01	<.01	<.01	.10	<.01	<.01	.02
TOTAL	4.33	3.85	5.03	3.91	3.84	3.96	4.20	3.85	3.87	3.69	3.14	3.85	4.45

TABLE D-7A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1976
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	25	23	94	252	160	36	36	22	21	20	25	23	61.4
Area (MH114-MH112)	323	237	238	261	250	260	735	465	430	496	340	270	358.8
MH112	5	4	4	3	3	14	4	9.5	15	24	5.6	6	8.1
Bldg. 3503 & 3508	≤.2	2	2	4	.8	2	2.5	1.7	3	3	2	2.4	2.1
Bldg. 3025 & 3026	9	4	4	2	3.2	2	2	1.7	2	3	2	2.8	3.1
Bldg. 3019	≤16	12	11	7	8.5	.6	32	7.7	11	22	5	8.6	11.8
Bldg. 2531	45	54	219	75	130	170	76	60	26	31	25	25	78
Bldg. 3525	.5	<1	.1	.2	<.1	.2	.5	.05	.3	.1	.04	Trace	.3
Bldg. 2026	.4	<1	.5	.7	.4	.2	1.7	.8	.3	.2	.4	.2	.6
Tank Farm Drainage Bldg. 3505, 3517	1020	570	655	389	55	399	579	345	240	565	594	1150	545.9
TOTAL	1034	908	1228	994	611	884	1469	913	749	1164	999	1488	1070.1

TABLE D-7A

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1976
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.4	.04	.13	.14	.22	.07	.07	.04	.04	.03	.04	.04	.11
Area (MH114-MH112)	.63	.44	.43	.50	.46	.42	1.17	.31	.44	.60	.37	.24	.50
MH112	.76	.75	.86	.87	.77	.90	.7	.59	.39	.83	.41	.49	.69
Bldg. 3503 & 3508	.01	.11	.11	.10	.13	.09	.12	.15	.14	.13	.13	.17	.12
Bldg. 3025 & 3026	.21	.19	.31	.16	.22	.26	.21	.23	.30	.57	.27	.50	.29
Bldg. 3019	.78	.73	.80	.83	.83	.59	.68	.77	.75	.44	.23	.20	.16
Bldg. 2531	.86	.85	.92	.73	.72	.52	.46	.53	.54	.70	.47	.71	.67
Bldg. 3525	.03	.01	.02	.02	.01	.04	.06	.04	.01	.02	.02	.03	.03
Bldg. 2026	.16	.18	.14	.13	.16	.15	.17	.14	.10	.09	.11	.08	.13
Tank Farm Drainage Bldg. 3505, 3517	1.28	.93	1.03	.78	.92	.85	.85	.69	.63	.85	.91	1.08	.9
TOTAL	5.12	4.23	4.75	4.26	4.20	3.98	4.58	3.47	3.03	4.05	2.93	3.50	4.02

TABLE D-8A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1977
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	32	39	40	110	17	10	<10	10	13	15	17	19	27.7
Area (MH114-MH112)	282	213	290	300	265	318	430	330	327	377	305	349	315.5
MH112	4	3.5	2	5	3	3	<10	<10	2	3	12	6	5.3
Bldg. 3503 & 3508	4	2.4	2	6	6	2	10	<10	2	4	0	4	4.4
Bldg. 3025 & 3026	7	2.4	3	10	2	5	10	<10	6	31	4	4	7.9
Bldg. 3019	11	2.4	4	10	2	11	<10	<10	39	10	4	3	9.7
Bldg. 2531	15	25	6	20	17	41	70	20	41	17	25	18	26.3
Bldg. 3525	.1	.1	<1	.1	.06	.1	<10	<10	0	0	0	0	1.8
Bldg. 2026	.2	1.2	<1	.1	.1	.1	<10	<10	1	0	2	0	2.1
Tank Farm Drainage Bldg. 3505, 3517	860	482	1090	810	462	563	520	44	961	1068	146	209	601.3
TOTAL	1215	771	1439	1271	774	953	1090	464	1392	1525	515	612	1002.1

TABLE D-8B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1977
(GROSS BETA, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.05	.08	.05	.09	.04	.04	.03	.03	.05	.005	.06	.06	.05
Area (MH114-MH112)	.31	.31	.34	.33	.36	.55	.68	.62	.57	.59	.60	.47	.48
MH112	.47	.39	.43	.59	.62	.45	.58	.52	.72	.57	.95	.89	.60
Bldg. 3503 & 3508	.15	.09	.12	.16	.09	.12	.12	.05	.07	.15	.16	.15	.12
Bldg. 3025 & 3026	.58	.36	.27	.70	.36	.24	.26	.41	.53	.27	.41	.48	.41
Bldg. 3019	.14	.19	.26	.20	.14	.15	.14	.17	.10	.10	.12	.15	.16
Bldg. 2531	.56	.43	.21	.32	.16	.29	.34	.28	.27	.39	.30	.22	.31
Bldg. 3525	.03	.01	.03	.05	.05	.11	.11	.10	.11	.11	.12	.12	.08
Bldg. 2026	.12	.10	.14	.16	.12	.14	.11	.10	.14	.09	.09	.11	.12
Tank Farm Drainage Bldg. 3505, 3517	1.01	.69	1.00	1.02	.69	.84	.75	.69	.93	.98	1.26	1.65	.96
TOTAL	3.42	2.65	2.85	3.62	2.63	2.93	3.12	2.97	3.49	3.26	4.07	4.30	3.29

TABLE D-9A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1978
(GROSS BETA, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	Avg. Gross Beta 5 Months
Area (MH234)	33	19	16	9	28	21.0
Area (MH114-MH112)	488	269	246	182	341	305.2
MH112	8	3	2	20	5	7.6
Bldg. 3503 & 3508	3	0	1	1	4	1.8
Bldg. 3025 & 3026	2	0	2	2	5	2.2
Bldg. 3019	6	2	2	4	3	3.4
Bldg. 2531	18	4	12	41	14	17.8
Bldg. 3525	0	0	<1	<1	<1	.6
Bldg. 2026	0	0	1	<1	2	.8
Tank Farm Drainage	2289	789	673	629	1023	1080.6
TOTAL	2847	1086	956	890	1426	1441

TABLE D-9B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1978
(GROSS BETA, MILLIONS OF GALLONS)

Area (MH234)	.06	.05	.06	.05	.10	.06
Area (MH114-MH112)	.32	.24	.36	.41	.61	.39
MH112	1.26	1.05	1.15	1.03	.70	1.04
Bldg. 3503 & 3508	.17	.18	.15	.09	.15	.15
Bldg. 3025 & 3026	.21	.21	.27	.25	.36	.26
Bldg. 3019	.15	.14	.18	.23	.25	.19
Bldg. 2531	.28	.23	.32	.24	.25	.26
Bldg. 3525	.12	.10	.10	.14	.12	.12
Bldg. 2026	.10	.08	.13	.09	.10	.10
Tank Farm Drainage	1.80	.92	.95	.74	.94	1.07
TOTAL	4.47	3.20	3.67	3.27	3.58	3.64

TABLE D-9C

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1978
(Sr-90, MILLICURIES)

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	7 Month Average
Area (MH234)	10	12	59	18	9	20	40	24.0
Area (MH114-MH112)	157	137	176	147	142	128	221	158.3
MH112	1	1	1	1	<1	1	3	1.3
Bldg. 3503 & 3508	2	1	3	1	<1	<1	<1	1.4
Bldg. 3025 & 3026	2	1	6	3	2	2	2	2.6
Bldg. 3019	2	3	3	3	3	3	6	3.3
Bldg. 2531	26	35	13	24	10	48	41	28.1
Bldg. 3525	<1	<	<1	<1	<1	<1	<1	1.0
Bldg. 2026	3	1	<1	<1	<1	<1	<1	1.3
Tank Farm Drainage	409	357	599	371	307	380	687	444.3
TOTAL	613	549	862	570	477	585	1003	665.6

TABLE D-9D

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1978
(Sr-90, MILLIONS OF GALLONS)

Area (MH234)	.06	.18	.20	.06	.06	.07	.06	.10
Area (MH114-MH112)	.68	.63	.57	.60	.63	.40	.63	.59
MH112	.77	.99	1.05	.55	.74	1.12	1.05	.90
Bldg. 3503 & 3508	.18	.19	.17	.16	.24	.27	.45	.24
Bldg. 3025 & 3026	.65	.73	.78	.61	.52	.36	.67	.62
Bldg. 3019	.19	.17	.20	.15	.19	.24	.30	.21
Bldg. 2531	.22	.24	.32	.29	.09	.38	.38	.27
Bldg. 3525	.13	.10	.13	.18	.23	.41	.31	.21
Bldg. 2026	.09	.15	.07	.07	.08	.07	.16	.10
Tank Farm Drainage	.81	.77	1.08	.84	.74	.84	1.20	.90
TOTAL	3.78	4.15	4.57	3.51	3.52	4.16	5.21	4.14

TABLE D-10A

LLW MAJOR CONTRIBUTOR'S MONTHLY ACTIVITIES 1979
(Sr-90, MILLICURIES)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	22	19	11	6	8	8							12.3
Area (MH114-MH112)	209	203	263	266	458	480							313.2
MH112	3	2	3	5	2	4							3.2
Bldg. 3503 & 3508	<1	<1	1	<1	<1	<1							1.0
Bldg. 3025 & 3026	<1	<1	1	<1	<1	<1							1.0
Bldg. 3019	7	3	3	1	1	<1							2.7
Bldg. 2531	3	4	6	17	13	59							17.0
Bldg. 3525	<1	<1	<1	<1	3	<1							1.3
Bldg. 2026	<1	<1	<1	<1	<1	<1							1.0
Tank Farm Drainage Bldg. 3505, 3517	714	528	870	848	1160	390							751.7
TOTAL	962	763	1160	1147	1648	946							1104.4

TABLE D-10B

LLW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1979
(Sr-90, MILLIONS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Area (MH234)	.08	.09	.13	.15	.18	.17							.13
Area (MH114-MH112)	.79	.65	.63	.63	.63	.72							.68
MH112	.97	.66	.63	.66	.67	.54							.69
Bldg. 3503 & 3508	.35	.44	1.09	1.18	1.22	.14							.74
Bldg. 3025 & 3026	.18	.24	.35	.36	.60	.53							.38
Bldg. 3019	.41	.20	.26	.273	.31	.247							.28
Bldg. 2531	.41	.30	.40	.32	.28	.27							.33
Bldg. 3525	.28	.20	.21	.29	.94	.05							.33
Bldg. 2026	.18	.13	.12	.04	.04	.03							.09
Tank Farm Drainage Bldg. 3505, 3517	1.24	1.01	1.65	1.62	2.28	.90							1.45
TOTAL	4.89	3.92	5.47	5.52	7.15	3.60							5.1

APPENDIX E

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY AVERAGE VOLUMES

TABLE E-1

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1970
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	81	37	27	23	21	20	34	35	24	29	28	35	394
ORR & BSR	28	65	40	38	44	22	24	18	22	19	17	17	354
HFIR	26	16	25	25	18	32	30	11		18	14	19	234
FPD	26	16	20	15					16	26		15	133
4500 Complex	23	21	22	15		19			12	27	19	15	173
Radiosotopes Process. Area	17	18	19	11		15	16	17	19	17	18	23	190
Transuranium Process. Area	-	-	-	-	-	-	-	-	-	-	-	10	10
Building 3026D				22	17	12	19	15					85
Building 3025					10								10
Molten Salt Reactor Exp.						13							13
Nuclear Safety Pilot Plant						10							10
Building 3508							18	14					32
SUBTOTAL	201	173	153	149	110	143	141	110	93	136	96	133	1638
TOTAL ILW VOLUME GENERATED	271	234	246	239	219	234	251	196	141	209	145	167	

TABLE E-2

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1971
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	22	33	31	35	28	20	17	25	17	18.9	17.1	13.3	277.3
ORR & BSR	27	28	35	18	24	27	25	26	33	20.4	13.05	29.8	306.25
HFIR	14	14	29	26	20	26	15	50	25	99.4	13.15	17.2	348.75
FPD	23	20	10	12	26	23	22	19	16	40.9	28.7	19.5	260.1
4500 Complex	15	16	24		21	15		14	19	22.2	21.5	29.4	197.1
Radiosotopes Process. Area	21	19	22	25	22	33	41	34	32	24.4	21.3	37.3	332.0
Transuranium Process. Area	12	-											12
Building 3508	10												10
Building 3026D		18	22	17	14	13	22	15					121
SUBTOTAL	144	148	173	133	155	157	142	183	142	226.2	114.8	146.5	1864.5
TOTAL ILW VOLUME GENERATED	185	197	252	172	216	215	223	261	261	312	191	240	

TABLE E-3

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1972
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	15.3	19.85	25	18.35	15.25	20	34.7	22.8	21.7	19.9	28.2	49	290.05
ORR & BSR	37.1	17.4	23.3	12.55	30.45	32.8	15.9	22.6	12	17.4	14.5	32.3	268.20
HFIR	19.6	27.75	24.15	19.75	19.05	26.2	17	45.7	16.5	33.4	13.9	12.9	275.9
FPD	33.3	13.4	16.5	14.55	21.55	19.2	24.8	34.8	22.8	26.4	15.4	41.2	283.9
4500 Complex	18.5	25.7	11.65	8.8	7.95	6.3	7	7.9	7.9	6.3	8.3	9.2	125.5
Radiosotopes Process. Area	38.7	27.05	30.7	24.75	19.95	22.9	30.9	21.7	24.4	31.1	30.9	36	339.05
Transuranium Process. Area						7.4	11.5	4.6	3.3	19.4	4.9	5	56.1
Buildings 3508 & 3503						9.9							9.9
SUBTOTAL	162.5	131.15	131.3	98.75	114.2	144.7	141.8	160.1	108.6	153.9	116.1	185.5	1648.6
TOTAL ILW VOLUME GENERATED	281.1	241.7	205.9	174.5	212.8	215	167	221	166	197	162	262	

TABLE E-4

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1973
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	35.8	38.9	43.2	23.2	35.9	20	23.9	18.8	25.3	16.9	25.2	23.6	330.7
ORR & BSR	19.2	24.3	32.6	21.7	40.8	28.4	29	19.5	10.3	14.4	22.5	16.9	279.6
HFIR	29.7	24	25	21.7	18.3	14.7	13.9	17.6	14.6	16.1	26.2	12.5	234.3
FPD	15.7	10.5	27.3	34.5	16.9	10.7	18	25.5	22.6	30.8	31.2	22.4	266.1
4500 Complex	5.7	8.3	23.5	3.4	26.2	12.8	21.1	34.6	8	12.1	11.9	14	181.6
Radiosotopes Process. Area	14.9	10.7	25.9	13	22.3	19.9	18.8	16	14.8	25.2	17.8	8.4	207.7
Transuranium Process. Area	4.3	6.5	5.5	5.5	2.2	3.7	4.3	3.3	4.9	1.1	6	4.8	52.1
SUBTOTAL	125.3	123.2	183.0	123.0	162.6	110.2	129.0	135.3	100.5	116.6	140.8	102.6	
TOTAL ILW VOLUME GENERATED	161	160	229	153	209	136	157	193	153	138	205	147	

TABLE E-5

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1974
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	36.1	24.9	21.5	14.9	24.7	16.2	11.3	18.1	17.4	18	NO	17.4	220.5
ORR & BSR	25.5	39.6	48.4	18.1	25.2	24.6	22.7	19.2	17.4	18.2	R	22.5	291.4
HFIR	22.2	24.4	14.2	7.9	19.5	24.7	24.8	29.3	9	14	E	24.3	214.3
FPD	19.4	11.9	14	3.7	12	30	41.4	28.7	22.3	23.3	P	8	214.7
4500 Complex	10.7	6.9	6.6	12.7	5.8	6.1	2.6	2.9	5.1	3.7	O	5.2	68.3
Radiosotopes Process. Area	21.3	8.1	9.4	11.5	12.7	7.2	5.7	7.5	6.5	5.6	R	9.7	105.2
Transuranium Process. Area	3.3	1.3	1.8	3.7	1.6	3.3	4.7	2.8	2.2	2.9	T	1.4	29.0
SUBTOTAL	138.5	117.1	115.9	72.5	101.5	122.1	113.2	108.5	79.9	85.7		88.5	1143.4
TOTAL ILW VOLUME GENERATED	179	138	148	106	151	143	147	115	146	103	107	149	

TABLE E-6

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1975
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	19	37.4	42.4	15.2	15.2	32.5	14.3	12.6	14.5	14.3	8.6	19.7	245.7
ORR & BSR	26.6	10.5	29.9	17.9	9.2	10.7	30.7	26.7	78.8	15.2	14.4	14.7	285.3
HFIR	20.3	25.6	26.4	15	25.4	35	21.3	26.8	15.9	16.2	23.2	21.8	272.9
FPD	15.8	13.6	18.3	8.2	14.7	9.1	5.1	9.9	4.3	4	2.9	9.7	115.6
4500 Complex	14.9	2.7	10.5	6.4	4.7	7.8	9.6	8.2	13.2	4.4	10.3	4.3	97.0
Radiosotopes Process. Area	8.4	6.8	8.6	4	7.2	10	5.6	5.9	7.1	5.5	6.6	6.6	92.3
Transuranium Process. Area	2.9	2.3	2.9	3.7	4.8	2.5	3.8	3.2	2.4	6.4	1.2	3.4	39.5
SUBTOTAL	107.9	98.9	139.0	70.4	81.2	107.6	90.4	93.3	136.2	66.0	67.2	80.2	1138.3
TOTAL ILW VOLUME GENERATED	166	137	199	109	108	152	107	109	170	91	80	116	

TABLE E-7

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1976
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	21.3	21.8	26.7	24.8	22.3	20	23.7	15.4	15.5	25.6	10.4	18.6	246.1
ORR & BSR	26.7	21.2	16.8	18.7	27.9	17	16.7	45.9	12.5	36.9	8.9	8.7	257.9
HFIR	31	30	13.5	46.1	14.3	14	6.7	12.9	15.8	13.4	6.5	8.8	213.0
FPD	9.9	8.1	0	2.1	10	0		6.4	17.6	11.9	7.5	10.5	84.0
4500 Complex	9.2	13.2	30.5	5.8	6.6	5.9	10.7	14.5	9.4	18.6	10.6	8.9	143.9
Radiosotopes Process. Area	7.9	8.9	16.9	13.9	10.7	20	9.7	8.9	8.9	12.4	5	6.6	129.8
Transuranium Process. Area	1.4	2	3.4	2.9	3.8	1.8	5.3	3	2.5	3.6	2.9	4.8	37.4
Bldg. 3505 Canal										30.6	5		
SUBTOTAL	107.4	105.2	107.8	114.3	95.6	78.7	72.8	107.0	82.2	153.0	56.8	66.9	1147.7
TOTAL ILW VOLUME GENERATED	154	132	139	140	125	100	91	128	95	178	68	91	

TABLE E-8

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1977
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	15	10.4	22	20.5	14.1	21.1	14.1	10.5	14	11.1	20.7	10.1	183.6
ORR & BSR	12.1	15.6	8.4	17.6	4	7.1	17.2	14.8	16.4	16.1	27.3	16	172.6
HFIR	14.8	10.2	14.7	14.9	24.4	7.8	26.6	25.6	8.7	22.9	23.6	7.8	202.0
FPD*	21.6	14.8	10.7	11.8	1.4	2.3	0	1.8	3.4	3.4	4.7	7.8	93.7
4500 Complex	8.5	3.8	9.9	14.2	4	12.2	5	13.6	11	14.7	14.5	7	118.4
Radiosotopes Process. Area	6.3	9.4	11.8	15.1	4.5	5.9	5.1	8.6	10.1	8.1	8	6.6	99.5
Transuranium Process. Area	2.7	2.2	9.1	6.8	1.7	2.3	2	1.8	3.2	3.6	3.4	1.5	40.3
Accumulated Surface Drainage, Shale Fracture						17							17
SUBTOTAL	91.0	66.4	86.6	100.9	54.1	75.7	70.0	76.7	66.8	79.9	102.2	56.8	922.1
TOTAL ILW VOLUME GENERATED	135	81	111	150	76	92	94	104	104	166	155	86	

*Storage tank pit has an in-leakage problem from groundwater. These figures represent the volume of water jetted from the pit during the month. The pit can only be jetted to ILW.

TABLE E-9

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1978
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	21.2	6.5	15.3	9.2	6.9	8.5	5.3	10.4	2.5	2.3	4.5	12.4	106.0
ORR & BSR	24.4	16	25.1	17.6	16.2	14.2	14.2	15.4	8.9	13.1	4.2	21.6	190.9
HFIR	17.4	17.5	13.7	13.9	29.1	25.9	16.7	19.9	7.9	8.9	26.2	29	226.1
FPD*	2.1			2.4	4.8	7	9.9	18.1	.9	2.1	3.5	4	55.8
4500 Complex	8.9	6.9	7.8	4.3	7.9	4.5	11.5	12.3	28.4	63.2	25	14.3	195.0
Radiosotopes Process. Area	4.5	7.2	8.8	7.2	9.7	10.8	12.7	16.5	12.2	5.3	9.5	14 2	118.6
Transuranium Process. Area	2.7	5.2	3.7	1.2	1.7	1.7	1.4	1.2					18.8
SUBTOTAL	81.2	59.3	74.4	55.8	76.3	72.6	71.7	93.8	61.8	95.9	72.9	95.5	911.2
TOTAL ILW VOLUME GENERATED	115	99	127	84	101	97	89	134	106	129	104	143	

*Storage tank pit has an in-leakage problem from groundwater. These figures represent the volume of water jetted from the pit during the month. The pit can only be jetted to ILW.

TABLE E-10

OR-ILW MAJOR CONTRIBUTOR'S MONTHLY VOLUMES 1979
(THOUSANDS OF GALLONS)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Building 3019	15.4	10.0	7.1	6.93	9.7	8.04							57.17
ORR & BSR	30.8	11.3	4.2	14.03	5.3	9.99							75.62
HFIR	35.9	13.4	16.3	32.25	22.0	7.28							127.13
FPD*	5.4	27.3	13.0	7.6	15.0	3.31							71.61
4500 Complex	15.0	8.3	13.1	8.87	9.8	9.26							64.33
Radiosotopes Process. Area	9.3	5.3	8.2	10.06	14.7	14.82							62.38
Transuranium Process. Area	2.8	2.9	2.8	1.3	2.5	0							12.3
SUBTOTAL	144.6	78.5	64.7	81.04	79.0	52.7							470.54
TOTAL ILW VOLUME GENERATED	199	108	112	126	137	108							

*Storage tank pit has an in-leakage problem from groundwater. These figures represent the volume of water jetted from the pit during the month. The pit can only be jetted to ILW.

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